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.

NEW SERIES. VOLUME XXI.

JANUARY-JUNE, 1905.

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CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EXECUTIVE PROCEEDINGS: REPORT OF THE GENERAL SECRETARY.

THE first meeting of the American Association for the Advancement of Science was held in the City of Philadelphia, September 20th, 1848. There were then 461 members of the Association, but we have no record of the number in attendance. The second Philadelphia meeting was held September 3, 1884. The Association then numbered 1,981 members and the attendance was 1,261, including 303 members of the British Association for the Advancement of Science and nine other foreign guests. The third Philadelphia meeting was held December 27 to 31, 1904. The total membership was nearly 4,000 and the registered attendance numbered 588 members and 104 members of affiliated societies, making a total registered attendance of 692 members. From 200 to 400 did not register, so that we may safely conclude that the total attendance was at least 890, and perhaps very much larger.* The present meeting is, therefore, the third largest in point

* We estimate the number of scientific men in attendance to have been in the neighborhood of 1,200. 240 members of the American Chemical Society were registered, but only 75 for the Chemical Section of the Association. There were nearly 100 members of the American Psychological and Philosophical Associations in attendance, very few of whom registered. The conditions were probably similar in other sciences.—ED.

of numbers since the year 1884. While numbers are not an index of the value of a meeting, they do show the amount of interest taken in its proceedings, and from that standpoint we may conclude that the third Philadelphia meeting was a success. It was also a success from the standpoint of number of papers read and the general interest in the papers, as well as in all of the proceedings of the association.

Tabulating the members according to the sections for which they registered, we find the following numbers:

Section A	57
Section B	66
Section C	75
Section D	16
Section E	79
Section F	104
Section G	103
Section H	44
Section I	14
Section K	25

giving a total of 581 who signified their preference as to sections.

These figures show that where a national scientific society met in conjunction with the association, the corresponding section was large and where a national scientific society did not meet, the attendance was very small. This would seem to indicate that members of the association prefer to attend a meeting of the national society rather than the meetings of the association unless the two meet together.

The University of Pennsylvania placed its halls and laboratories freely at the disposal of the association and each day furnished a lunch to the members. The association has never received more careful attention than it received at this meeting. A vote of thanks was extended to the university, the details of which will be found later on in the report.

In former years a daily program has been published, showing the papers to be read that day and giving a list of the members in attendance. This has always been a severe drain upon the resources of the association and it was decided this year to use but one program, which was distributed to members on the first day papers were read. This single program seemed to answer its purpose as well as the daily programs have in the past, except that many members missed the lists of those in attendance. If some method can be devised by which members may know who are present, there can be no objection to the single program.

Since the last meeting of the association 377 members have been elected; although this is not as large as the number elected in previous years, yet it shows a steady growth and a growing interest on the part of the public in the work of the association.

There has always been great difficulty in getting reports of the association and its work published in the daily papers, except those in the city where the meeting is held. This year the Committee on Policy of the Association instructed the permanent secretary to appoint a press secretary. The permanent secretary appointed Mr. Theodore Waters. Reports of the meetings were prepared each day and sent to most of the prominent newspapers of the country. It was impossible to make the reports as full as desired, as some of the members of the association who read papers did not give their abstracts to the press secretary, although they were requested to do so. If the readers of papers will take pains to see that their abstracts are in the hands of the press secretary, entirely satisfactory reports can be sent out in future. It is greatly to be desired that the press of the country give some attention to the meetings of our greatest scientific society.

The two questions of general interest were the time of meetings of the association and our relation to the affiliated societies. These questions have been actively discussed before, but they do not seem to be definitely settled in the minds of many. The sections which have been in the habit of giving excursions and those who study objects out of doors, prefer a summer meeting, but it seems that a large majority of the association is in favor of the winter meetings, as the general committee unanimously decided to hold the next meeting during the winter. The committee on policy reported that it had considered this matter and would recommend that this general committee request the next general committee to hold a summer meeting in Ithaca during the summer of 1906. The success of this meeting will undoubtedly have a great deal to do with settling the question of summer meetings.

There seems to be no objection on the part of the association to holding two meetings each year, one during the winter and one during the summer. The expense involved would be considerable, but the association can bear it and perhaps the best solution of the problem will be two meetings. This is a question which the future must decide.

AFFILIATED SOCIETIES.

The following Affiliated Societies held sessions in conjunction with the association:

American Alpine Club.
The American Anthropological Association.
The American Chemical Society.
The American Folk-Lore Society.
The American Geographers' Association.
The American Mycological Society.
The American Philosophical Association.
The American Physical Society.
The American Psychological Association.
The American Physiological Society.
The American Society of Naturalists.
American Society of Vertebrate Paleontologists.
Association of American Anatomists.
The Association of Economic Entomologists.
The Astronomical and Astrophysical Society of America.
The Botanical Club of the Association.
The Botanical Society of America.
The Society for Plant Morphology and Physiology.
The Society for the Promotion of Agricultural Science.
Sullivant Moss Chapter.
The Wild Flower Preservation Society of America.
The Entomological Club of the Association.
Eastern Branch of American Society of Zoologists.
The Fern Chapter.
The Geological Society of America.
The Sigma XI Honorary Scientific Society.
The Society of American Bacteriologists.
The Society for Horticultural Science.
The Southern Society for Philosophy and Psychology.
The Pelee Club.

The association is still pursuing the policy of encouraging the great national societies to meet at the same time and place with it. The association secures rooms, provides accommodations, makes arrangements with hotels and railways and in all points takes charge of general arrangements without expense and without trouble to the affiliated societies.

Nearly, if not all, of the societies meet in perfect harmony with the respective sections. In almost every case the sections have charge of the general session in one half of the day and the affiliated societies have charge of the meetings during the other half of the day. Thus there is no friction and papers are presented before both bodies, while there is the additional advantage of a larger attendance at both the section and the society. It is hoped that this arrangement will appeal still more to the national societies until all of them enter into this arrangement with the association.

The attendance of the members of the societies this year indicates that they are willing to cordially cooperate with the association and turn out in large numbers to attend these joint meetings. There is nothing in the arrangement which prevents an affiliated society holding a separate meeting at any other time of the year if it chooses.

The first session of the fifty-fourth meeting of the American Association for the Advancement of Science was called to order in College Hall Chapel, University of Pennsylvania, Philadelphia, Pa., at 10 A.M., Wednesday, December 28, 1904, by the retiring president, Dr. Carroll D. Wright. Dr. Wright introduced the president-elect, Dr. William G. Farlow, who made a brief address. Provost Harrison, of the University of Pennsylvania followed with an address of welcome.

President Farlow thanked Provost Harrison for his words of welcome and then asked the general secretary to make the announcements from the council.

Mr. Howe (general secretary): The Council has voted to extend the privileges of associate membership for this meeting to members of the local committee, residents of Philadelphia and vicinity and to members of the affiliated societies.

The following committees have been appointed to serve during this meeting:

Committee on New Members: The permanent secretary and the secretary of the Council.

Committee on Fellows: The general secretary and the vice-presidents of the sections, Mr. Howe, chairman.

Committee on Grants: The treasurer and the vice-presidents of the sections, Mr. R. S. Woodward, chairman.

It has been decided to hold sessions of the Council at nine o'clock in the morning, but there will be no other general session until Saturday morning at ten o'clock.

Dr. Calvert, secretary of the local committee, made some announcements in behalf of that committee in regard to the arrangements which had been made for the comfort and convenience of the association.

After the adjournment of the general session the several sections were organized in their respective rooms.

In accordance with a suggestion from the committee on the policy of the association, the vice-presidential addresses were scattered throughout the week, instead of being given on the same date.

It was thought best to have in addition to a vice-presidential address, one or more papers of general interest, which would follow the address, thus taking up the greater part of that session.

The general program of the week was as follows:

GENERAL EVENTS.

The council of the association met daily from December 28 to December 31, inclusive, at 9 A. M., in the auditorium, Houston Hall.

WEDNESDAY, DECEMBER 28, 1904.

Meeting of the council at 9 A. M., as above.

First general session of the association at 10 A. M., in the chapel, College Hall.

The meeting was called to order by the retiring president, Dr. Carroll D. Wright, who introduced the president-elect, Dr. W. G. Farlow.

Addresses of welcome were delivered by members of the local committee.

President Farlow replied.

Announcements by the general, permanent and local secretaries.

Agreement on the hours of meeting.

Adjournment of the general session, followed by the organization of the sections in their respective halls.

At 1:00 P. M.

Luncheon to the members of the association and societies in the gymnasium.

At 2:30 P. M.

Addresses of vice-presidents as follows:

Vice-President Tittmann, before the Section of Mathematics and Astronomy, in College Hall. Subject, 'The Present State of Geodesy.'

Vice-President Bancroft, before the Section of Chemistry, in the Harrison Laboratory of Chemistry. Subject, 'Future Developments in Physical Chemistry.'

Vice-President Russell, before the Section of Geology and Geography, in Geological Laboratory, College Hall. Subject, 'Cooperation among American Geographical Societies.'

At 8:00 P. M.

Address by Dr. Carroll D. Wright, the retiring President of the Association, in the gymnasium. Subject, 'Science and Economics.'

At 9:00 P. M.

Reception by the Provost of the University of Pennsylvania, Dr. C. C. Harrison and Mrs. Harrison, in the Museum.

THURSDAY, DECEMBER 29, 1904.

Meeting of the council at 9 A. M.

Meetings of the sections at 10 A. M.

At 1:00 P. M.

Luncheon to the members of the association and societies in the gymnasium.

At 2:30 P. M.

Addresses of vice-presidents as follows:

Vice-President Hall, before the Section of Physics, in Morgan Laboratory of Physics. Subject, 'A Tentative Theory of Thermo-Electric Actions.'

Vice-President MacBride, before the Section of Botany, in Biological Hall. Subject, 'The Alamogordo Desert.'

Vice-President Mark, before the Section of Zoology, in Laboratory of Physiology and Pathology. Subject, 'The Bermuda Islands and the Bermuda Biological Station for Research.'

Vice-President Baldwin, before the Section of Social and Economic Science, in Logan Hall. Subject, 'The Modern Droit d'Aubaine.'

At 8:00 P. M.

The retiring President of the American Chemical Society, Dr. Arthur A. Noyes, delivered a lecture, illustrated by experiments, on the 'Preparation and Properties of Colloidal Solutions,' in the Harrison Laboratory of Chemistry.

FRIDAY, DECEMBER 30, 1904.

Meetings of the council at 9 A. M.

Meetings of the sections at 10 A. M.

At 1:00 P. M.

Luncheon to the members of the association and societies in the gymnasium.

At 2:30 P. M.

Addresses of vice-presidents as follows:

Vice-President Woodward, before the Section of Mechanical Science and Engineering, in the Mechanical Laboratory. Subject, 'Recent Progress in Engineering Education.'

Vice-President Saville, before the Section of Anthropology, in the Museum of Science and Art. Subject, 'Mexican and Central American Archeology.'

At 10:00 P. M.

Meeting of the General Committee at the Hotel Walton.

SATURDAY, DECEMBER 31, 1904.

Meeting of the council at 9 A. M.

Final general session at 10 A. M., in the chapel, College Hall.

Meeting of the sections following the adjournment of the general session.

At 1 P. M.

Luncheon to the members of the association and societies in the gymnasium.

EXCURSIONS.

Excursions to the following plants were arranged by the local committee:

Belmont Filtration Plant (filtration of city water).

F. A. Poth & Sons Brewery.

J. P. Baltz Brewing Company.

Eddystone Print Works, Eddystone, Pa. (bleaching and dyeing of all kinds of cotton goods, engraving and preparing the rolls).

Barrett Manufacturing Coo. (refined coal-tar chemicals).

Baldwin Locomotive Works.

Atlantic Refining Co. (petroleum oils).

Cramp's Ship Yard.

Camden Coke Company (Otto-Hoffman by-product coke ovens).

United Gas Improvement Co. (coal and water gas).

Hulton Brothers (dyeing and finishing).

Forth & Foster (dyeing and finishing).

United States Arsenal.

United States Mint.

United States Navy Yard.

Gillinder's Glass Works.

High Pressure Fire Service Plant, kindness of Mr. F. L. Hand, Chief of the Bureau of Water, Philadelphia.

Philadelphia Electric Co.'s new Power Station, through the kindness of Mr. J. B. McCall, President Phila. Electric Co.

Philadelphia Subway, through the kindness of Mr. W. S. Twining, chief engineer, and Mr. Charles M. Mills, principal assistant engineer, Subway and Elevated Railway Construction.

Wm. Sellers & Co., Inc., through the kindness of Mr. William Sellers and Mr. Coleman Sellers, Jr.

On Monday evening, December 26, 1904, the American Physiological Society held a smoker at the University Club.

On Tuesday evening, December 27, 1904, Professor W. F. Osborn gave a lecture before the American Society of Naturalists in the Academy of Natural Sciences on the subject, 'Recent Discoveries of Extinct Animals in the Rocky Mountain Region and their Bearings on the Present Problems of Evolution.' On the same evening the American Society of Naturalists and the affiliated societies gave a smoker at the University Club.

Wednesday afternoon, December 28, 1904, was held the annual discussion of the American Society of Naturalists on the question 'Mutation Theory of Organic Evolution.' This was participated in by Dr. D. T. MacDougal, Professor W. E. Castle, Professor E. G. Conklin, Professor W. B. Scott, Professor T. Dwight, Professor L. H. Bailey and Dr. W. M. Wheeler. In the evening the annual dinner of the American Society of Naturalists was held.

On Thursday evening, December 29, the American Chemical Society held a commers at the University Club. The same evening the Psychological and Philosophical Association held a smoker. The same evening the Society of the Sigma Xi held a convention in College Hall.

Friday evening, December 30, the American Alpine Club held its annual dinner at the University Club.

The council elected as members of the council at large, J. McK. Cattell, J. M. Coulter and H. F. Osborn.

Professor C. R. Barnes, of the University of Chicago, Dr. H. C. Cowles, of the University of Chicago, and Mr. C. L. Shear, of the U. S. Department of Agriculture, were appointed as representatives to the International Botanical Congress to be held in Vienna in 1905. The reports of committees and the list of fellows elected will be printed in the next issue of Science.

AMENDMENTS.

The following amendment to the constitution which was proposed at the St. Louis meeting, favorably acted upon by the council and reported to the general session, was adopted:

Amend Article 34 by the omission of the words "On the election of any member as fellow, an additional fee of $2 shall be paid."

The proposed amendment of article 4, line 2, to read "The members of at least one year's standing, who are professionally engaged in science and have, by their labors, aided in advancing science" was unfavorably reported upon by the committee on policy.

POLICY OF THE ASSOCIATION.

The council appointed Mr. R. S. Woodward permanent chairman of the committee on policy of the association.

The council voted that the committee on policy of the association be requested to exercise a general executive control of the preliminary arrangements for meetings and of the publications, subject to the control of the council.

The committee on policy of the association reported the following resolutions which were adopted:

"That the permanent secretary be authorized to offer sets of the back volumes of the *Proceedings* to libraries, which shall be approved by the committee of the association appointed by the president."

"That the publishers of Science be requested to announce prominently that cut copies will be sent to members who request it."

"That the committee recommends as members, and if they become members, nominates as fellows, members of the national scientific societies not now members of the association in cases in which the national scientific society has a qualification for membership equal to that of the qualification of the association for fellowship. The following societies are accepted as having such qualifications:

The American Society of Naturalists.
The American Philosophical Society.
The American Academy of Arts and Sciences.
The Association of American Anatomists.
The Association of American Physicians.
The Association of Pathologists and Bacteriologists.
The Astronomical and Astrophysical Society of America.
The Botanical Society of America.
The Geological Society of America.
The American Mathematical Society.
Active members of the American Ornithological Union.
The American Philosophical Association.
The American Physical Society.
The American Physiological Society.
The American Psychological Association.
The American Society of Bacteriologists.
The Society of Plant Morphology and Physiology.
The American Zoological Society.

The following resolution was referred to the committee on policy of the association:

Resolved, that the year book of this association be hereafter sent bound to such members as may notify the permanent secretary of their desire to receive it in that form. Binding to be in cloth or boards, as the treasurer and secretary may think proper.

Dr. W. H. Hale introduced the following resolution, which was adopted:

Resolved, That the American Association for the Advancement of Science hereby extends its hearty congratulations and best wishes to Dr. Martin H. Boye, a founder of this association, and the only surviving founder of the parent association, that of American Geologists, afterwards called the American Association of Geologists and Naturalists, which was founded in this city in 1840, Dr. Boye being present at that time, as well as at the founding of the American Association for the Advancement of Science in 1848.

Professor C. M. Woodward introduced resolutions thanking the officers of the University of Pennsylvania and other institutions that had entertained the association and these were unanimously adopted.

At the meeting of the general committee, Friday evening, it was decided to hold the next meeting in New Orleans, the work of the association to begin Friday, December 29, 1905. Boston was recommended as the place of the meeting in 1906.

The following officers were elected for the New Orleans Meeting.

President—Professor C. M. Woodward, St. Louis, Mo.

Vice-Presidents:

Section A—Professor W. S. Eichelberger, Washington, D. C.

Section B—Professor Henry Crew, Evanston, Ill.

Section C—Professor Chas. F. Mabery, Cleveland, Ohio.

Section D—Professor F. W. McNair, Houghton, Mich.

Section E—Professor Wm. North Rice, Middletown, Conn.

Section F—Professor H. B. Ward, Lincoln, Neb.

Section G—Dr. Erwin F. Smith, Washington, D. C.

Section H—Dr. Geo. Grant McCurdy, New Haven, Conn.

Section I—Professor Irving Fischer, New Haven, Conn.

Section K—Professor Wm. T. Sedgwick, Boston, Mass.

Permanent Secretary—Dr. L. O. Howard was elected for a period of five years beginning August, 1905.

General Secretary—Professor C. A. Waldo, Lafayette, Ind.

Secretary of Council—Professor John F. Hayford, Washington, D. C.

Secretary Section K—Dr. Wm. J. Gies, New York City, N. Y.

Charles S. Howe,
General Secretary.

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*LINES OF PROGRESS IN ENGINEERING.**

The engineering army, like the myriads of well-trained, well-equipped and well-organized soldiers of the Mikado, stretches from high ground to high ground along an extended front, facing the hosts of conservatism who are entrenched behind moats

* Address of the vice-president and chairman of Section D—Mechanical Science and Engineering, 1904.

of difficulties, redoubts of prejudices, batteries of tradition and in citadels of ignorance. Like the Japanese, the division commanders, looking well to their supplies of ammunition (*i. e.*, correct theories) and their daily rations (*i. e.*, materials of construction and shop practise), push forward now at one point and now at another, capturing hill after hill, now on the right, now on the left, and now in the center. The army of science never retreats; it forever forces back the frontiers of darkness, and solves problem after problem from the endless list of secrets with which the storehouses of nature are filled.

It is a glorious thing to belong to this engineering army, to rejoice in its triumphs and to share in its rewards. Its success is not accidental; its triumphs are not matters of chance. Engineering blood always tells. Just as we train our best soldiers and sailors at West Point and at Annapolis; and as our appliances at military and naval schools keep pace with the arts of war on land and sea; so our schools of engineering, if they are up-to-date institutions, keep pace in the theories they teach and in the laboratories they equip with the best engineering practise. Every advance at the front (to resume my simile) means an advance of all supplies and in the enlisting and training of recruits. I am by profession a recruiting officer, and I am engaged with my fellow officers in training and equipping men for the firing line and the front rank. That the new material we send forward may be just what is wanted, we must have information as to the progress making and the next points of attack. In short, our schools of engineering must know the lines of engineering progress.

I am well aware that I shall not be able to touch upon many of the important matters which my subject is sure to bring up, and I can not expect to take them in the order of their importance. Probably no two of us would agree upon their relative importance; one's environment has so much to do with what lies just beyond his horizon; so I doubt not you will supplement my statement with most interesting and valuable suggestions.

THE UTILIZATION OF WASTE ENERGY.

While much has been done and much more is doing at waterfalls and river rapids, large and small, the work of saving the energy which now runs to waste has but just begun. When the great waterfalls are utilized the rapids will remain. We are lost in wonder when we calculate the possibilities. Measure the volumes which rush over the 'Sault St. Marie,' as the waters of Lake Superior drop to the level of Lake Huron; and then again put your measuring rods into the vastly greater volumes which plunge and rush from Lake Erie to Lake Ontario; and still again through the rapids of the St. Lawrence to the sea level. At every vantage ground, the work of utilization has begun and no man now living will see that work stop. Turn next to smaller streams and mountain torrents—what fields open up to the hydraulic and electric engineers! Mountain reservoirs will serve the triple purpose of preventing destructive floods, of saving the energy for useful work and of aiding irrigation. At every count the doors open wide for the best of engineering enterprise and the best of engineers, hydraulic, mechanic, electric, irrigation, and the echo of each department must be heard in the engineering lecture-room and laboratory. The electric transformer has made the transmission of energy possible from mountain slopes to far cities, and has unlocked bewildering amounts of energy at thousands of points deemed hitherto inaccessible. No one can see far into the future, but we all easily see the dawn of a new era of energy saving. The streets of this city may yet be lighted by the energy which now runs to waste at Niagara. In St. Louis we look to the slopes and canyons of the Rockies for our supply of sweet, wholesome water—we may yet look to the same regions for the energy to drive our cars and run our mills.

COMBUSTION ENGINES.

The clumsy steam-engine, with its wasteful furnace, its huge boiler and chimney, is doomed. It has done great work in producing available energy and in wasting still more. It has played a most important part in modern civilization, and it deserves well at our hands, but nothing can stay the decree of progress. Sentence will soon be pronounced, but the day of execution has not been set. I never expect to see the day when steam power plants will cease to exist, but my children will see such a day.

Think for a moment of the present complicated, indirect method of procedure for converting the energy stored in coal into mechanical energy in a moving piston or a revolving shaft. Coal and air are fed into a furnace where combustion converts them into great volumes of a mixture of hot gases. The greater part of the heat and all the volume of these gases escape through the chimney; a small part of the heat only is drawn off by the steel shell and tubes of a boiler and transmitted to a body of water, which is thereby transformed into steam. The steady generation of steam against high pressure, added to its expansion as the pressure is reduced, enables it, when conducted to a cylinder, to drive a piston or revolve a shaft, thereby producing mechanical power. The clumsiness of the operation is equalled only by its wastefulness, which varies from 88 per cent. to 95 per cent.

The problem to-day is: What is the most direct and most economical road from coal to moving machinery? Engineers are attacking this problem on all sides, and attacking it successfully—gas-engines, and combustion-engines of various sorts bear witness. The future prime-mover will burn (not explode) its fuel in the working cylinder, and the piston will be driven, first by the products of combustion as their volume increases, and secondly by their expansion against a diminishing resistance. I predict great things of the Diesel motor. Originally it was designed to burn powdered coal mixed with hot compressed air; but crude petroleum was found to be preferable. So long as oil flows abundantly from wells, oil will generally be used, but powdered fuel, native or prepared, will doubtless prevail ultimately. The economy and directness of the combustion motor can not be excelled, and when a few years of study and experiment have been applied to the work of simplifying the mechanism (it was a century from James Watt to a triple-expansion Corliss), we may expect it to come into general use for all great central power stations.

The vitality of the steam-engine is due to-day to the mechanical perfection of its design. Its simplicity is marvelous. It is started and stopped with the greatest ease and it almost takes care of itself. The invention of the steam turbine has probably given to the furnace and steam-boiler another lease of life. The wonderful adaptability of the turbine for electric generators is something which was not anticipated.

Will not some one design and construct a combustion engine which shall consume continuously oil and compressed air, thus maintaining a high pressure in a gas chest and driving a turbine with the products of the combustion used expansively as is now done with steam? The proposition is an attractive one, both for the lecture room and for the engineering laboratory. It is sufficient now to call attention to its possibility, and to indicate a point for study and progress.

It will not be amiss for me to quote the figures given me by the engineer in charge of the Diesel engines which drove the generators for power and light in the 'Tyrolean Alps' at the late world's fair in St. Louis.

These engines, three in number, of 225 horse power each, were the observed of many observing engineers during the seven months of the fair. The assistant engineer in charge kept daily records of the work done, and fuel used, and kindly gave me a sample of his reports. The details are extremely interesting. The work was measured at the switchboard, no allowance being made for loss of energy in the engine, air pump and generator. The total work of the three engines between noon and midnight was 2,768.5 K.W.H. This is equivalent to 3,711 H.P.H.

Total fuel used (Indiana oil), 266 gals.
Fuel per 100 K.W. hours, 9.58 gals.
Fuel cost in car-tank lots, 3c. per gal.
Cost per 100 K.W.H., $0.287.
Cost of the day's fuel, $7.98 or 2.15 mills per H.P.H.

Thus one cent paid for the fuel for one horse power for four hours, forty minutes.

The three engines worked under about two thirds of a full load and used three gallons of lubricating oil during the day.

The above figures seem to me little less than remarkable.

While still wasteful, as nature measures energy, these engines are several times as efficient as the better styles of ordinary steam-engines. Doubtless they lack simplicity and the certainty of action which comes from experience and close study; but I can not help feeling that the road to the future 'prime mover' runs hard by the construction shops of an internal-combustion engine. Let students and professors take warning.

ARTIFICIAL CENTERS OF POWER.

One of the most important openings for future engineering enterprises is the establishment of large power centers, not only where water power is available, but where fuel is abundant as well.

Take, for example, the vast coal mines in the vicinity of the city of Philadelphia and those in the vicinity of St. Louis. In each case the power for industrial establishments and all kinds of moving machinery, large and small, in use in the city, including the street cars and the rolling stock on all roads, can well be furnished by electrical currents from large generating establishments near the mines. Add to the above the establishment of gas works sufficiently large to furnish all the gas needed for illumination, for gas-engines, for heating and cooking purposes in a great city. In the case of St. Louis those gas works should be near the extensive coal mines of Belleville and other coal-producing regions only a few miles from the city.

The effect of these two great steps forward upon the physical and sociological characteristics of a city can hardly be overestimated. The ultimate economy and convenience of such installations are enough to justify them. We have yet to learn how cheaply fuel gas and electric currents can be furnished to large concentrated groups of consumers. But omitting all questions of mere financial economy, what a saving in health, beauty and enjoyment! The London fogs which we hear so much about are produced largely by London smoke, and the prevention of smoke will to a very great extent be the prevention of the fog. I look forward to the day when, instead of a small volcano of smoke from a brick crater above every house, St. Louis will have all its heating and cooking done by gas, and all power will be furnished by electric currents, or by gas and combustion-engines, both gas and electricity coming from the gas works and power plants at the mouths of the coal mines in Illinois. What an era of cleanliness and comfort this presages! This era of cleanliness will be brought about by the engineers. Hence engineering education must see to it that engineering students are prepared for their high mission. The proposed 'Million Club' of St. Louis bears no comparison with a possible 'Clear Sky Club.' The former proposes to seduce 250,000 non-resident smokemakers into joining the 750,000 smokemakers already resident in St. Louis, thereby making smoke enough to shut out the sun entirely (they almost did it during a whole week last November). The 'Clear-Sky Club,' on the other hand, will propose to eliminate all smokers by sending coal-burning power plants to the mines, thereby leaving the city so clean and beautiful that 250,000 lovers of pure air, clear skies and godliness will seek homes among us of their own accord. The elimination of smoke, soot and ashes will make St. Louis absolutely bright and clean, and similar improvements here would go far towards producing the same beneficial results in the city of Philadelphia. Already our cities have, or are making arrangements for, an abundant supply of pure water. This has been and still is a great branch of engineering, and it deserves an important place in our schools of engineering. We must next provide pure air and a clear sky.

These steps forward involve no very great addition to our engineering knowledge, but they give opportunity for engineering enterprises, and they show most clearly how essential cooperation is in such work. Large power plants and extensive gas works require much private capital, unless we fly to the extreme of public ownership. The economic construction of large power plants and gas plants; the laying of pipe lines and an unprecedented amount of electric cables, all or nearly all underground, constitute a great field and furnish great engineering opportunity.

THE PURIFICATION OF RIVERS.

We have nearly reached the limit in river pollution. The public welfare will soon make an imperative demand for a halt. A great city like Chicago shall no longer load with poison a little stream like the Illinois, nor foully pollute a great river like the Mississippi. Let me frankly admit that even the city of St. Louis shall not forever dump and pour its refuse into the Mississippi River.

When the national government takes up the function of guarding every stream from pollution (and no state government can deal effectively with the problem) we shall have a great extension of the sphere of sanitary engineering. The recent discoveries by Dr. George T. Moore, of the Department of Agriculture, suggest the possibility of purifying a polluted stream so as to make it not only clear and sweet, but absolutely free from algæ and all harmful bacilli. The proper disposition of house drainage and the refuse of factories is already a live engineering problem in Europe, and American engineers must no longer neglect it. The study of diseases and their prevention is forcing its way into engineering schools, as preliminary to extensive engineering practise. Whatever form the solution of the problem may take, it will involve both chemical and hydraulic engineering, and the fundamental principles of both must be carefully laid in our schools.

TUBULAR CONSTRUCTIONS.

In the near future we are likely to make great progress in the construction of rolling stock and moving machinery, as well as in the construction of bridges and buildings.

The adoption of electricity by railroads for all kinds of traffic will result, in the first place, in the disappearance of the heavy locomotive. So long as the locomotive was needed to pull a long train of cars, great weight was necessary, and the weight of railway engines and the strength of bridges have been increasing at a rapid rate. We saw a locomotive at the recent fair at St. Louis weighing over 200 tons. It was a monster, indeed. Should such locomotives become common, every bridge in the country would have to be rebuilt.

But when each car, whether for passengers or for freight, has its own motor and drives itself, the heavy locomotive is no longer needed. Moreover, the car itself should be made as light as possible consistent with strength. Weight is of no advantage to a self-driven car. The bicycle has taught us a great lesson in the art of construction. A maximum of strength and stiffness with a minimum of weight. This already prevails in girders and bridge constructions. The same principles should be applied to all rolling stock and moving machinery. Tubular axles, tubular spokes, tubular fellies, tubular shafts, tubular everything is to be the law of future construction. All the great steam-engines and propellers already have hollow shafts, and I predict an enormous increase in the amount and precision of hollow steel tubing manufactured and used in the next ten years. The mechanical and material advantage of tubular shafting is easily stated. Thus: (1) If a solid cylindrical shaft be compared with a hollow shaft of the same weight per foot of length, but whose exterior diameter is n times as great, the strength of the hollow shaft in torsion is $2n - 1/n$ times as great as that of the solid shaft. (2) If only equal strength is required, the solid shaft having one nth of the diameter of the tube, will weigh $2n - 1/n^2$ times as much. For a numerical example: (a) A thin tubular shaft four inches in diameter is seven and three fourth times as strong as a solid shaft one inch in diameter which weighs the same per linear foot.

(b) A solid shaft weighs seven and thirty-one thirty-seconds (call it eight) times as much as a tubular shaft of equal strength and four times its diameter.

The ratio of stiffness of the tube to that of the solid shaft is even greater.

At the recent St. Louis fair a prize of $2,500 was offered for the lightest motor per horse power. Motors up to 100 horse power were eligible. The prize was not awarded, for the reason that inventors and constructors of motors were not prepared to submit their apparatus to the rigid tests required for efficiency and durability; but the offer was made with distinct intention of stimulating the construction of motors which should be suitable for vehicles where lightness combined with great strength is a desideratum, such as in automobiles and air-ships.

STEEL AND CONCRETE AND CEMENT.

I scarcely need call your attention to the important part which steel-concrete constructions are destined to play in future structures. Originally all important bridges, walls and dams were built of stone, and masonry flourished as a fine art. Arches, groined and cloistered, segmental and gothic, elliptic and parabola, combined to make cathedrals and chapels beautiful, and bridges stately and strong as well as durable. Then came the era of iron and steel, and stone bridges were built no more. Steel trusses, posts and girders took the place of stone walls and granite arches. We are now going back to masonry walls and to masonry bridges, but the masonry is no longer granite; it is concrete reenforced by steel. Evidently the opening for engineering theory and engineering enterprise is most extensive. The new material is not subject to corrosion, so it will not be eaten up by rust. It is incombustible, and is not easily melted or weakened by heat, and above all it is inexpensive and easily handled. The field is a great one, and both the theory and the practise of steel and concrete combinations enter, or should enter, into the curriculum of every student of civil engineering and architecture. In the Austrian building at the recent fair in St. Louis there was a model of the centering of an arch, evidently steel-concrete, of 80 meters span (262 feet). You will remember that the beautiful and imposing 'Cabin John Bridge,' built of granite, in Washington, D. C., the greatest stone arch in the United States, has a span of 220 feet.

The recent enormous increase in the manufacture of Portland cement is an indication of the coming demand. It has taken thousands, perhaps millions, of years in the laboratory of nature, to produce the masses of granite and the layers of marble and limestone; the engineer and the chemist, working together, produce from the abundant supplies of material near at hand an artificial masonry in a few hours. Of its strength and durability the engineering laboratory and a brief experience tell us much. The verdict of a thousand years is still to be rendered, but here again the hand of promise points our way.

AERIAL NAVIGATION.

Above I casually mentioned air ships. You must bear with me while I say several things about aerial navigation.

We have been accustomed to regard the problem of practically navigating the air as one which could not be solved, or, at any rate, as a sort of fad hardly deserving of mention in connection with engineering. It will be remembered that the late eminent engineer, Professor J. B. Johnson, would not admit that aerial navigation was a possibility. He classed it with the problem of perpetual motion. But a careful examination of all the conditions seems to me to point towards the possibility of progress, and all that we can at present claim for many desirable improvements is that they admit of progress. We can not with any confidence predict the rate of progress. Some of the things I have already pointed out bear directly upon the problem of aerial navigation; two in particular: The use of tubular constructions for the maximum of strength and the minimum of weight; and the construction of motors which are strong and light; but many problems must be solved before we can really navigate the air.

It was my privilege to be connected with the discussion of aerial matters at the late fair in St. Louis. Without my knowledge I was selected as the president of the aeronautic congress, in which the problems of aeronautics were carefully discussed. That congress had no functions whatever in regard to aerial exhibits, or attempts to exhibit air ships, at the world's fair. The latter feature of the fair I regret to say was a deplorable failure. The greater part of the failure was inevitable, since aerial experimentation is expensive and difficult, and it has very rarely been undertaken by scientific people. What has been anywhere in that direction has been for the most part crude, ill-advised and unscientific, and failures have generally attended any attempts to actually navigate the air. Of course there are exceptions in the character of the investigations made. I could mention four Americans who are approaching the problem carefully and on scientific lines. Some of their investigations and experiments are full of promise for the future of aerial navigation.

So far as the failure of the spectacular part of aeronautics at the fair was concerned, that failure was due very largely to the vandalism of some crazy crank or rival, who cruelly mutilated the air ship brought over by Santos Dumont at great expense, to be used during the summer in

St. Louis; and especially was the failure due to the most unfortunate and unwarranted charge which a police officer made in response to a call for a report in regard to the mutilation of 'Santos-Dumont No. 7.' Being unable to get any clue to the guilty wretch (who had plenty of time to slip in and slash the gathered silk in hundreds of places while the guard sipped his coffee in a booth a few hundred yards away), and feeling doubtless that he must give some explanation, he actually stated that in his opinion the injury was inflicted either by Santos-Dumont himself or by some one of his men. No more injurious, unwarranted or insensate charge could have been made, and no person who was in any way acquainted with Santos Dumont could have made it; and yet that charge became current in the newspapers and was half believed by a great many very respectable people far and wide. Doubtless the currency of that charge did much to discourage and repel Santos Dumont from our shores. That he should have received such treatment in America was surprising and greatly to be regretted. It went far to give us a bad reputation in European circles. We are credited with hostility towards European inventors and experimenters. I trust Mr. Santos Dumont may eventually learn that Americans as a rule are fair-minded, generous and friendly towards all experimenters in every field. I trust he may learn that not one, so far as I know, of the gentlemen who were associated with him during his two visits to St. Louis sympathizes in any way, or to any extent, with the insinuations thrown out against him by the officer above referred to.

From this digression I now turn to the subject in hand, namely, the possibility of progress in the art of aerial navigation. Regarding progress in aerial navigation as entirely possible, I notice that it depends upon the solution of many problems, and no successful air-ship can reasonably be expected to appear until these problems are solved.

There are two lines of attack, which, while differing in one respect, have very much in common. Investigators are naturally divided into two classes: One seeking to devise methods for navigating the air as birds do, which gain support and propulsion solely from mechanical and muscular energy; and the other relying for support, more or less, upon the buoyancy of hydrogen gas, while securing propulsion by means of propellers. All are clearly interested in motors, whether the air-ship moves with or without the support of a bag of hydrogen. All are concerned with methods of management, and with the adoption of means for directing the movements of an air ship through the air.

If a gas bag is to be used, it is evident that the shape of the bag which involves the least amount of resistance is of first importance, and if that bag is to be a diminishing quantity, the ship must secure support from the use of aeroplanes or curved surfaces as the craft is driven rapidly forward. It is evident that the character of supporting surfaces and their distribution are matters of first importance in all cases. The number of preliminary lemmas which must be solved before the main proposition is reached is readily seen. The recent aeronautical congress concerned itself wholly with discussions and reports of experiments upon these preliminary matters, and I can truthfully say that excellent work was done.

I spoke of the gas bag as being a diminishing quantity. I wish to add a few words to make my meaning clear. When it was first proposed to propel an ocean ship by means of mechanical power, it was assumed as a matter of course that the ship itself could float upon the water, and that mechanism was to be employed solely for the purpose of driving it forward and for steering it. In aerial navigation the case is different. The ship is not only to be driven forward, but it must be supported. The analogous case, therefore, is not that of an ocean ship, but of a heavy swimmer who must both support and drive himself forward. Swimming does not come to boy or girl by nature, and the skillful teacher furnishes a temporary support while the learner masters the art of using his hands, feet and legs correctly. Accordingly, he applies either a buoyant bag of air between the boy's shoulders, or the gentle lift of a string attached to a pole, and thus supports the learner while he masters the mechanical details of swimming. This exterior lift or support is a diminishing quantity as the pupil progresses, and when correct motions are learned and become automatic, the pupil swims and external aid is no longer necessary.

Similarly, as it seems to me, aerial navigation is to be accomplished. At first the craft may very properly be supported by a bag of hydrogen. Something must hold the structure which is to carry motor, propellers, fuel, ballast, steering apparatus, aero-planes, etc., above the ground, in comparatively still air, while tests can be made and skill in management can be acquired. Infinite patience, plenty of money and first-class engineering culture and skill will be required. The various elements must be studied one at a time, while a friendly gas bag holds the experimenter aloft. When an engineer can build a durable and well-portioned motor and system of propellers, which shall be as strong as twenty horses and only as heavy as twenty geese; and when he can drive his supporting bag of hydrogen through the air at the rate of twenty or thirty miles per hour, he can reduce the size of his bag and get support from aeroplanes and curved surfaces, and learn to manage them. The smaller the gas bag, the less the resistance of the air; consequently a greater velocity; consequently a greater lift of the aero-surfaces; and again a less demand upon the hydrogen —and so on, to final victory. American skill, ingenuity and experience will triumph provided that experience is cumulative. Men must learn from twenty failures how to succeed the twenty-first time in one thing. As I said: Patience, money and time are necessary. I wish Andrew Carnegie, or some other 'captain of industry' who is in danger of dying rich, would establish and endow an 'aeronautical experiment station and laboratory,' and then place it in charge of a physicist like Professor Zahm, and an accomplished mechanical engineer like Mr. Blank. In ten years such men, under such conditions, would go far towards a solution of the problem of aerial navigation.

FUNDAMENTAL PRINCIPLES.

Some one proposed to teach a nation patriotism by writing popular songs for its schools. There was a world of wisdom in the suggestion, for the foundations of character and the guiding principles of life are generally laid at school. That is why the great teacher is such a power in the world.

Is it not so in engineering? Are not a few fundamental propositions of mechanics what one must fall back upon when a new problem is encountered? And does not the probability of one's seeing new problems and of solving them depend very largely upon one's absolute mastery of those few fundamental propositions? If you agree with me and answer these questions in the affirmative, then it follows, in our opinion at least, that the lines of progress in engineering will depend largely upon the complete equipment of our schools and the thoroughness with which the basic doctrines are instilled into the life blood of the students. It is said of Benjamin Franklin that he could not take a walk nor go on a journey without seeing all about him unsolved problems and new illustrations of universal laws; and with Franklin to see a problem was almost the same as to solve it.

MANUAL TRAINING.

I can not close this rambling address without referring to a recent improvement in secondary education which is likely to affect favorably engineering education, and through that education promote the future of engineering itself. I refer to the introduction into high schools and academies of the study of tools, materials and the mechanical processes. At the age of fifteen the expanding boy feels the thrill of increasing strength, and a natural hunger and thirst for contact with material things. The instinct to handle things, to do things, requires guidance or it becomes belligerent and destructive. The material universe is to be solved by every one for himself; if in no better way, it will be by pulling things to pieces to see how they are put together; by breaking things to see how strong they are; and by making new things if he only know how.

Then and there are the time and place for manual training; not for a trade or a profession, nor even for fun and pleasure; but for culture and a conscious mastery of tools and materials, and of the arts of construction. During the secondary stage of education the student should find himself and get an intelligent insight into the world of mind and matter around him. Both inborn aptitude and external opportunity should justify the coming engineer. The new educational feature goes far to develop the one and to discover the other. The fruit of well-organized and logical manual training is clear thinking, strong, vivid concepts, a world of knowledge gained first-hand, a power and habit of mental analysis of concrete problems—all of which admirably prepare the boy to take up, as a man, the study and practise of engineering. We have all seen something of this rich fruit, and have tested its value. In my judgment, it bodes well for engineering. Like Franklin, these young men (and they are swarming through our manual training schools and knocking in increasing numbers at the doors of our technical schools and colleges) will see things, and solve things, and make things move. The promise of the future is glorious; splendid is the era now dawning; fortunate in their opportunity are the young engineers with clear heads and skilled hands who are coming to the front; and happy are we who, to the best of our ability, are helping on the higher civilization which good engineering makes possible.

Calvin Milton Woodward.

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*PROBLEMS IN HUMAN ANATOMY.**

For the solution of the problems presented to him, the anatomist is by no means limited in his technique to the scalpel or the microscope, but justly claims the right to use every aid to research which other departments of science are able to furnish. His position, therefore, in the scientific field is determined by the standpoint which he occupies and from which he regards animal structures, rather than by any special means and methods employed for their study.

By common consent, anatomical material includes not only structures which may be easily dissected and studied with the unaided eye, but also those which tax the best

* Address prepared for the Section of Human Anatomy at the International Congress of Arts and Science, at St. Louis. Owing to the unavoidable absence of the writer, this address was not delivered.

powers of the microscope for their solution. But even within such wide limits the material that ordinarily comes to hand leaves much to be desired, and in elucidating this or that feature in the structures under examination, it is often found necessary to modify the physiological conditions under which these structures have been working, in the hopes that their appearance may be altered thereby, and so be more readily understood.

Taken in a broad way, this is the reason why the data of pathology and experimental morphology are so important for the development of anatomical thought, helping as they do in the solution of the problems connected with the finer structure of the animal body, just as embryology and teratology illuminate the gross morphological relations in the adult.

I am quite aware that in making the foregoing statements I have suggested more modes of investigation than are at present used in connection with man. But the anatomy of the human body in adult life forms in itself so limited a field that no investigator can possibly confine himself to this portion alone, and there is every reason for here treating the subject in the larger way. As we see from the history of human anatomy, it was brought into the medical curriculum in response to the demands both of physiology and surgery, but gradually became most closely associated with the latter. For a long time its relative significance as a medical discipline was very great, because it represented the only real laboratory work which appeared in the training of the medical student. Indeed, a generation ago the exactness of anatomical methods was so lauded in comparison with the methods then commonly used in medicine, that anatomists came to scoff at the vagueness of their colleagues, while to-day, if we may be persuaded by some of our physiological friends, they have remained only to prey on the time of students who might be better employed. Although such a thrust may be readily parried, it is, nevertheless, necessary to admit that times are changed, and that as a laboratory exercise human anatomy is to-day outranked by several of the subjects in which the laboratory work permits a more precise formulation of problems and their more rapid and definite solution. However, it still retains, rightly enough, much of its former eminence.

Among the problems in human anatomy, there is, perhaps, none more important than the way in which it is to be presented to the five young gentlemen ranged around a subject in the somewhat trying atmosphere of the dissecting room. Just what they may be expected to learn from such an experience would require some time to state. Certain it is that these beginning anatomists are almost all of them intending to become physicians, and some of them to become surgeons, and to this end they are building up a picture of the human body which will be useful to them in their profession. They are doing this by the aid of the best pedagogical means at their command, namely, the reinforcement of the ocular impressions by the contact and muscular sensations that come from the actual performance of the dissection itself. If previously they have had some experience in the dissection of the lower mammals, they will note at once the differences shown in the case of man, and if their embryology is at their command, it will be easy for them on suggestion or on their own initiative to appreciate how some of the peculiar relations between parts of the human body have been developed. Beyond this the information obtained is of the same order as that of the vocabulary of a language. The student gets a certain number of discrete pictures of the different parts of the body more or less clearly impressed upon his mind, and when he has occasion later to deal with these same parts, he has the advantage of finding himself in the presence of familiar structures. How far in this first experience the special groups of facts which are sometimes set apart under the head of surgical anatomy should be introduced, is a more or less open question. The present weight of opinion demands that they should still be kept by themselves. Nevertheless, while the anatomical experience of the average medical student should rest on a broad scientific background, he should at the same time have a distinct appreciation of the eminently practical value of the information he is expected to acquire.

The question at once arises how the monotony of long-continued dissection can be relieved, and the student maintained in a condition of sufficient receptivity to make the work really worth while; for the acquisition of vocabularies has never been counted as one of the greater pleasures of life. There are several legitimate devices. In the first place, if it is possible for the student to have near at hand a microscope which may now and then be used for the examination of the different tissues as they appear in the cadaver. This cross reference between the gross and microscopic appearance will serve to bring into close connection with one another two classes of facts which are often separated to their disadvantage, and to revive the histological pictures which should be incorporated in gross structures, but which in most cases remain forever apart from them. On the other hand, a search for anomalies or variations serves to give both a reality and purposefulness to the work and to make a student feel that in return for the large amount of time necessarily required for his anatomical training, he is, in some small measure at least, contributing to the science. It is unavoidable, this expenditure of time, and absolutely necessary, that the student should do these things with his own hands in order to obtain the three-dimensional impression of the structure with which he deals.

In this connection just a word as to the way in which the beginner may be aided in the comprehension of his work. The excellent diagrams and pictures which are now used to illustrate the best anatomical text-books carry us as far as that means of assistance can probably go. Pedagogical experience points strongly, however, to the superior value of the three-dimensional model, and although such models are more difficult to collect, harder to care for, and require more space and caution in their use, they are so far superior to any other device, except an illustrative dissection itself, that the collection of them in connection with anatomical work becomes a moral obligation.

If we turn now to the wider uses which may be made of anatomical material as it usually appears in the dissecting room, we find that a number of directors of laboratories have been utilizing this material for the accumulation of data in such a form that it may be later treated by statistical methods. Thus they have weighed and measured in different ways various parts of the cadaver, and in some cases determined the correlations between the organs or parts examined. It can not be too strongly emphasized that the results thus obtained are to be used only with the full appreciation of the fact that the material ordinarily available for examination in the dissecting room belongs in all countries to a social group which contains the highest percentage of poorly developed and atypical individuals. The conclusions, therefore, that can be drawn from the investigations of this material must always be weighted by its peculiar nature. To illustrate what is here meant by the peculiar character of this material, we may take as an instance the bearing of the results obtained from material of this sort on the problem of the brain weight in the community at large. It must be admitted that the figures which we have at our command for this measurement are, with the exception of one short list, derived from the study of individuals belonging to the least fortunate class in the community, and it is not fair, therefore, to carry over these data and apply them directly to the average citizen who is of the normal type and moderately successful in the general struggle for existence. From what has been said, it is plain that much of the work now being carried on in the dissecting room comes very close to the lines which have been followed for years by the physical anthropologists, yet because these have for the most part concerned themselves with the study of the skeleton, have limited their comparisons to the various races of men and have developed no interest in surgery, they have for a long time stood apart, and only recently joined forces with the professional anatomists. This step has certainly been to the advantage of anatomy, and as one result of it, anatomical material not previously utilized will now be treated by statistical methods. But all the work to which reference has here been made is on the body after death. So manifest are the disadvantages arising from the conditions which are thus imposed, that the necessity is felt on all sides of extending our observation as far as possible to the living individual. As an example of such an extension, we have the determination of the cranial capacity and brain weight in the living subject which has resulted from the labor of Karl Pearson and his collaborators.* The methods which have been employed for this purpose are capable of giving as accurate results as are ordinarily obtained from post-mortem examinations, and, moreover, have the advantage of being applicable at any time to any group in the community which it is desired to investigate.

* Pearson and collaborators, *Phil. Trans. Roy. Soc.*, 1901.

To redetermine, as far as possible, from studies, on the living, all the relations which have been made out, post-mortem becomes a very immediate and important line of work.

But even under the general limitations which apply to the dissecting room material, it is desirable to refine our knowledge of the human body by classifying the subjects according to race, and thereby bringing into relief the slight anatomical differences that exist between the well-marked races of Europe and the races of other parts of the world. The history of anatomical differences due to sex lacks several chapters, and it is possible also to show the modifications of structure which come from the lifelong pursuit of certain handicrafts which call for peculiar positions of the body or for the unusual exercise of certain muscles; as, for example, the anatomy of a shoemaker.*

Such results as the one last mentioned have a direct bearing on the modifications of the human form which may be introduced by peculiarities of daily life and work, and bring anatomy into connection with the problems of sociology; while, on the other hand, both lines of work are contributory to the broader questions of zoological relationship and susceptibility to modification.

Yet when we have gained all the information which the scalpel can give, there still remains the whole field of finer anatomy, the extent of which it is so difficult to appreciate.

While recognizing that the human body

* Lane, W. A., *Journ. of Anatomy and Physiology*, Vols. XXI. and XXII., 1887 and 1888.

may be regarded as a composite, formed by the fitting together of the series of systems, and while in some instances we have more or less accurate notion of the way such a system appears—as, for instance, in the case of the skeleton—yet a much better understanding of the relation of the soft parts would follow an attempt to extend this method of presentation, and to construct phantoms of the body in the terms of its several systems in some way which would show us the system in question as an opaque structure in a body otherwise transparent. This is, of course, the final aim of the various corrosion methods, or those which depend on injection or differential coloration of structures which may be viewed in three dimensions.

When the vascular, lymphatic, nervous and glandular systems can be thus exhibited for the entire body, or for the larger divisions of it, it will be possible to see the human form transparently, and to see it whole; a feat difficult to accomplish, but worthy of earnest endeavor. The development of such phantoms should serve to make more impressive the familiar fact that in many organs and systems the total structure is built up by a more or less simple repetition of unit complexes, as, for example, the liver by the hepatic lobule, the bones by Haversian systems, and the spinal cord by the neural segments.

If we pass now from the consideration of the systems of tissues to that of their structural elements, we enter the domain of histology and cytology. Starting with the differentiation of the tissues by means of empirical staining methods, investigators have gradually come to appreciate the chemical processes which underlie the various color reactions, and as we know now, there already exist methods for determining in the tissues several of the chemical elements, such as iron, phosphorus, etc., to say nothing of the more or less satisfactory identification of complex organic bodies by means of definite reactions. This being the case, it is possible to imagine representations of the body built up on the basis of these micro-chemical reactions, representations which would show it in the terms of iron or in the terms of phosphorus, thus yielding us an image which might be compared with that obtained by aid of the spectroscope when the picture of the object is taken by means of one out of the several wave-lengths of light which come from it.

The contemplation of the multitudinous opportunities for investigation and comparison which appear within this field, lead us to pause and inquire what is properly the purpose of all this anatomical work; for without a strong guiding idea we are liable to repeat the errors of earlier generations, and merely accumulate observations, the bearing of which is so remote from the actual course of scientific progress that the investigations are mainly useful as a mental exercise for the individuals who conduct them. Anatomical results begin to have a real meaning only when correlated with physiology, and when we learn that a tissue with a certain structure is capable of performing given functions, we feel that we are really bringing our anatomy into touch with the life processes. It is to aid in the accomplishment of this end that men devote their lives to anatomical work. With the variation that we find everywhere in organic structures, it should be and is possible to discover by comparison what variations in the structure of a tissue or a cell are accompanied by the best physiological responses. It is along this line that we must necessarily work in order to reach human life either through medical practise or through other avenues of approach, for in the end the object and purpose of all science is to ameliorate the unfavorable conditions which surround man, and in turn to produce a human individual more capable of resistance to disturbing influences, and better suited for the enjoyment of the world in which he lives.

Considering anatomical work with this thought in mind, the problems which it presents can be grouped according to their relative value and importance. The approach may be made from two sides. On the one hand it is, for example, extremely worth while to direct years of labor to the determination of the finer structure of living substance, because the more closely we approximate to a correct view of that structure, the more readily will our anatomy and physiology run together, and the clearer will be the conception of the sort of structure which it will be most desirable to increase for the attainment of our final purpose. On the other hand, if we follow the path from the grosser to the finer anatomy, we are led to inquire whether there is any one part or system of the human body which at the present moment is specially worthy of attention. When we say that the nervous system is such a part, I think that even those who are not engaged in the study of it will admit that there are some grounds for the statement. The peculiar feature which sets the nervous system apart is the fact that its enlargement, both in the animal series and during the development of the individual, is in a very special way accompanied by changes in its physiological and psychological reactions. To be sure, we think of it as built up fundamentally by the union of a series of segments, but the relationship established between these segments becomes ultimately so much more important than the constituent units that in the end we find ourselves working with a single system of enormous complexity rather than a series of discrete units, a state of affairs which is not paralleled in any other tissue. In addition to this, the nervous system as a whole is par excellence the master system of the body, and as such, the reactions of the organism are very largely an expression of its complexity. Indeed, within the different classes of vertebrates, the various species may be regarded as compound bodies composed of four fundamental tissues and a species could well be defined by the quantitative relations found to exist between the nervous, muscular, connective and epithelial constituents. Working from this standpoint, Dubois,* the Dutch anatomist, stimulated by the work of Snell,† has brought forward evidence for the view that when, within the same order, several species of mammals similar in form, but differing in size, are compared with one another, the weight of the brain is found to be closely correlated with the extension of the body surface, and by inference with the development of the afferent system of neurones. This view would seem to imply that in these cases there is the same density of innervation of each unit-area of skin; but the correctness of this inference can only be determined by the careful numerical study of the afferent system of the animals compared. It will appear, however, that under the conditions imposed, the relative weight of the brain depends upon the fact that each unit-area of skin, represented by the nerves which supply it, calls for a correlated addition of elements to the central system, and thus the increase in one part is followed by a corresponding increase in the other. When, however, the large and small individuals within the same species are compared, it is found that the increase in the brain weight follows quite another law, and that in this latter case it is relatively much less marked than in the former. This

* Dubois, *Archiv f. Anthropologie*, 1898.

† Snell, *Archiv f. Psychiatrie u. Nervenkrankheiten*, 1892.

result at once suggests that the mechanism of the increase is dissimilar in the two cases. For the solution of the problems that are raised by such investigations as those just cited, we need to employ quantitative methods, and on this topic a word is here in place.

Microscopic anatomy and histology, like all the sciences, have passed through a series of phases which are as necessarily a part of their history, as birth, growth and maturity are a part of the life history of a mammal. The microscope in its early days enabled Schwann to propound the fruitful theory that the tissues were composed of cells. A preliminary survey showed that these cells were different in their form and arrangement in the different parts of the body, and a still more careful examination with the aid of various dyes or solutions altering the tissues in the differential way gave the basis for yet finer distinctions. This phase in the development of the science, however, may be fairly compared with qualitative work in chemistry, where the object is to determine how many different substances are presented in the sample examined. Naturally, the next step is the introduction of quantitative methods, and we are, therefore, now using the methods of weighing, measuring and counting for the purpose of rendering our notions more precise, and thereby facilitating accurate comparisons. When emphasizing this point, we do not, however, forget that hand in hand with this quantitative work the qualitative tests have been marvelously refined, and that these necessarily form the foundation for quantitative work, since all such work must deal with the elements or groups of elements which can be sharply defined, and the basis for their definition is given through qualitative studies. As progress is made along these lines, we appreciate more and more that it is of importance for us to know not only how much brain and how much spinal cord by weight normally belong to a given species of animal, but also the *quantitative relations* of the different groups and classes of elements which compose these parts. We are continually asking ourselves how far the range in gross weight of the central nervous system may be dependent on changes in the number of elements in the different divisions or localities, and how far dependent on the mere increase in the bulk of the individual units without any change either in their absolute number or relative size. Work along this line rests, as we know, on the neurone theory, that epoch-making generalization concerning the structure of the nervous system which was put forward by our honored colleague, Professor Waldeyer.* Most of us are aware that, at the moment, this theory is the subject of lively and voluminous discussion, and that Nissl,† for example, urges the inadequacy of the conception on the ground that it does not account for the gray substance in the strict sense.

No one can fail to appreciate the very great importance of the satisfactory conclusion of the present dispute, and earnestly desire that we may obtain conclusive evidence on points involved; but however the question of the gray matter may be settled, the enormous importance of the neurone conception, and the value of it for the purposes of the microscopic analysis of the nervous system, will remain untouched, while our quantitative determinations applied to the neurone as we now understand it, will still have a permanent value.

Returning to the questions which are raised by the previously mentioned investigations of Dubois, we require in the first instance to determine the number of neu-

* Waldeyer, *Deutsche medicinische Wochenschrift*, 1891.

† Nissl, 'Die Neuronenlehre und ihre Anhänger,' 1903.

rones connecting the skin with the central nervous system, and to see how this number varies in the different species of mammals similar in form but unlike in size. There is only one animal, the white rat, on which as yet such studies have been made, so that the whole field lies practically open. Should we be able to get good numerical evidence in favor of the view that under the conditions named above, the afferent system could be taken as an index of the size of the brain, it would show us at once that in the laying down of the nervous system certain proportions were rather rigidly observed, and bring us to the next step, namely, the determination of the influences which control those proportions and the possibility of effecting an alteration in them. In the meantime, there is every reason to prepare for the application of these results to man, and although the program here is simple enough to state, it will involve great labor to carry it through.

So far as the numerical relations in man are concerned, we have, through the work of Dr. Helen Thompson,* an excellent estimate of the number of nerve cell bodies in the human cortex, and through that of Dr. Ingbert,† a reliable count of the number of medullated nerve fibers in the dorsal and ventral roots of the thirty-one pairs of spinal nerves of a man at maturity. It is easy to see, however, that we must get some notion of the amount of individual variation to which these relations are subject within the limits of one race and one sex before it is desirable to attempt to learn whether the difference in race or sex here plays an important rôle. It is to be anticipated, however, that the differences dependent upon race and sex will be comparatively slight, and especially so when contrasted with the differences which we may anticipate as existing between the adult and the child at birth. This aspect of the problem illustrates, in a concrete form, the sort of question which is raised by the anatomical study of the body during the period of growth. The embryologists have worked out the formation and early developmental history of the various organs and parts of the human body, but the study of the later fœtal stages have been blocked by the scarcity of material, and the inconvenience of dealing with it. On the individual at birth, we have again more extensive observations, but for the period comprised between the first two years of life and the age of twenty our information is again scanty. The lower death rate during this part of the life cycle, as well as social influences, combine to keep material between these ages out of the dissecting room. Here is an important part in the life history of man which needs to be investigated along many lines, and during which it is most desirable to have a record of the changes in the nervous system expressed in quantitative terms. In the general problem which is here under discussion, our next step would be to enumerate in man at birth the medullated nerve fibers in the roots of the spinal nerves. Such an enumeration will probably show us between birth and maturity a very large addition to the number of these fibers, but we still have to determine at what portion of the period, and according to what laws, this addition takes place. At this point our observations on animals will assist us, and we should certainly look for the occurrence of greatest addition during the earlier part of the growing period.

Let us assume then that we have obtained results which show us the normal development of this portion of the nervous system between birth and maturity. These observations could be used as a standard. Once possessed of such a standard, we are

* Thompson, *Journ. of Comp. Neurol.*, 1899.

† Ingbert, *Journ. of Comp. Neurol.*, 1903 and 1904.

prepared to determine variations in the nature of excesses or deficiencies, and in this instance the question of deficiencies is the one most easy to handle.

The studies of Dr. Hatai* on the partial starvation of white rats during the growing period show that very definite changes can be brought about in the nervous system when these animals are deprived of proteid food for several weeks. As a result of such treatment, the total weight of the nervous system is reduced much below that of the normal rat. Such a result, however, leaves two points still undetermined; (1) the general nature of the changes bringing about a diminution in weight, and (2) the parts of the system in which changes occur. In testing our animal material by quantitative methods, we should in the first instance direct attention to a possible decrease or arrest of growth in the afferent system of sensory nerves, and seek to determine whether the unfavorable conditions have not retarded the growth process in this division of the nervous system. If the results of such observations are positive, we may expect to find a corresponding modification in man, when the human body during the period of growth is subjected to unfavorable conditions of a similar nature. As a matter of fact, such unfavorable conditions do exist in the crowded quarters of our larger cities, and it seems highly probable that we have there in progress examples of partial starvation quite comparable with the experiments conducted in the laboratory. Under these circumstances, it is important to discover in the case of our animals how far a subsequent return to normal food conditions will modify the anatomy of a nervous system which has been subjected to proteid starvation for some weeks. At present there are no observations which indicate whether or no recovery in the nervous system will take place, and it will probably require some time to reach a definite conclusion. The work necessary for a determination of the anatomical changes exhibited by the animals alone constitutes by no means a light task, since in order to obtain reliable results and to eliminate the factor of individual variation a series of individuals must be examined, and it requires a very definitely sustained interest to carry through the long line of enumerations necessary for such an investigation. The examination of the growth of the nervous system in animals subjected to definitely unfavorable conditions, is, however, only one part of the work.

It will be necessary to contrast the changes there found with the effects of special feeding, care and exercise in other groups, in order to see how far above the ordinary form the nervous system can be anatomically improved by any such treatment, and experiments in this direction are already being conducted by Dr. Slonaker. Of course the results which have been obtained and may be obtained on the animals studied in this way should not be directly applied to the case of man, because it seems quite evident that the higher organization of man is responsible for his ability to resist to a remarkable degree the disturbing effects of an unfavorable environment. The impression is abroad that the reverse is the case, and that it is man who is more responsive to unfavorable surroundings. I believe, however, that this current view will prove to be incorrect, for the lower mammals at least, and that when we place such animals where the conditions for them are abnormal, their limited powers of adaptability lead them to be more seriously affected than are animals which are more complexly organized. If such is the case, variations of the same amount should not be expected to appear in man, but there is every reason to assume that the variations

* Hatai, *American Journal of Physiology*, 1904.

which do appear will be of the same general character and that we might look for them in the human nervous system where we find them in that of the rat. When it is possible to see how the anatomy of the nervous system may be altered during the post-natal growth period, we shall be prepared to take up the problem of how it may be improved during embryonic and fœtal life, and how the actual number of potential neurones is determined, and their relative distribution controlled, and this should lead ultimately to the attempt to breed animals with improved nervous systems in which we shall know the nature of the improvement in considerable detail.

It may be urged that putting the problems in this way indicates a greater interest in the application to physiology of the anatomical results than in the results themselves. But I take it that the interest of a machinist in building a machine is to make the parts for one that will go, and that no less honor is due him for his painstaking care in determining the construction of the different parts and their right relations, because at the end of the operation he has devised something capable of doing work. Similarly, it is possible that a man's interest from day to day shall be absorbed in the technique of anatomical science, and yet it is nevertheless distinctly advantageous, if his anatomical observations bear on the performances of the living animal, and a final result is obtained which is the synthesis of research in two associated fields.

In drawing up the preceding outline, no one is more aware than the writer of the fact that problems connected with the nervous system have alone been considered. Without doubt those more interested in the other systems of the human body could duplicate for these the problems which have been suggested in connection with the nervous system, so that the account given above may be taken simply as an illustration of the sort of thing that seems worth doing. In presenting these illustrations it has been my purpose to indicate a standpoint from which the anatomical problems can be profitably regarded, and to draw attention to the use of quantitative methods in the study of anatomy, and especially as applied to the body during the period of active growth.

Yet perhaps the largest of our problems and certainly one which appeals to all of us, is the ways and means for the solid advancement of our science. Alongside of the question of how we shall hand down to successive generations of students the facts already established, lies the still more fundamental problem of the best method of building up the body of anatomical knowledge.

It is not my purpose to advocate as a means to this end the sharp separation of teaching from investigation. It is a rare man who can stand the strain of such a division, whether he chooses one or the other, and there is, moreover, much to be said for such an arrangement as will bring the average student into a laboratory where he can himself see how research work is conducted. Yet it would be possible to name institutions in which the relative amount of time required for teaching as compared with that left free for investigation might with advantage be readjusted, and almost all of our educational institutions at the same time admittedly lack the funds, and not often the educational purpose, which would justify them in attempting to meet the various difficulties connected with anatomical investigations on a large scale. Yet no one questions the importance of striving for a more rapid advance. A response to this feeling finds its expression in the several research funds which are now available in this country and abroad for the endowment of investigation, and in the plan presented to the International Association of Academies, and, it should be added, largely due to the initiative of Professor Waldeyer, for the establishment in various countries, of special institutes for the furtherance of research in embryology and neurology.

These two subjects were first selected owing to the peculiar difficulties of obtaining the needed material, and the great labor necessary to prepare the complete series of sections which are required in many cases. These conditions make it imperative that if we would avoid large loss of labor and much vexation of spirit, the work in these lines should be coordinated, standards adopted and the material of the laboratory, like the books of a library or the specimens in a museum, be available for the use of other investigators. Nothing, I believe, is further from the minds of those engaged in this plan than an attempt to produce anatomical results on a manufacturing scale. But the questions calling for solution in the fields here designated are so numerous, that such an arrangement will merely mean a subdivision of labor in which each institute will take one of the larger problems and direct its main energies to the study of this, so conducting the work that it shall be correlated with that in progress elsewhere. The director of such an institute will be justified in extending his work through assistants just as far as he can carry the details of the different researches in progress, and thus knit them into one piece for the education of himself and his colleagues. When we pass beyond this limit, admittedly subject to wide individual variation, there is little to be gained, but the evils of excessive production, should they arise, carry within themselves the means of their own correction.

This step, which is assuredly about to be taken, should enable us in the future to do things in anatomy not heretofore possible, and when, some years hence, there is another gathering of scientific men, with an aim and purpose similar to that of the present one, it is easy to predict that we shall be able to listen to a report on the important advances in anatomy arising from coordinated and cooperative work.

Henry H. Donaldson.
University of Chicago.

SCIENTIFIC BOOKS.

Ideals of Science and Faith. Essays by Various Authors. Edited by the Rev. J. E. Hand, editor of 'Good Citizenship.' New York, Longmans, Green & Co. 1904.

Were this book not remarkable in itself, its motive would render it remarkable in any ease. We readers of Science devoted, most of us, to absorbing technical subjects, may well peruse it to our great advantage, and realize a few tendencies of the day, unfamiliar to us maybe, and assuredly not clear in their main outlines.

The plan of the work is novel, even daring, and conjures up piquant expectancy. It consists of ten essays, each from a different hand, and divided into two groups. The first group, of six, under the general title 'Approaches through Science and Education,' deals with the possible contemporary relations between science and religion (relations of an irenical nature) from the standpoint of the lay expert. The subjects, and the authors who speak for them, are as follows: 'Physics,' Sir Oliver Lodge; 'Biology,' Professor Arthur Thomson, of Aberdeen University; 'Psychology,' Professor Muirhead, of the University of Birmingham; 'Sociology,' Mr. Victor V. Branford, secretary of the Sociological Society of London; 'Ethics,' the Hon. Bertrand Russell, fellow of Trinity, Cambridge; 'General and Technical Education,' Professor Patrick Geddes, University Hall, Edinburgh. The second group, of four essays, entitled 'Approaches through Faith,' presents the clerical standpoint in its various phases as follows: 'A Presbyterian Approach,' the Rev. John Kelman, of Edinburgh; 'A Church of England Approach,' the Rev. Ronald Bayne; the Rev.

P. N. Waggett contributes an essay entitled 'The Church as Seen from the Outside,' in which he concludes by stating the High Anglican, as opposed to the so-called Erastian, view; while, very fittingly, Mr. Wilfred Ward speaks for the Church of Rome. The editor furnishes a worthy introduction.

Obviously, in such a collection, comparisons were odious. But it may be of interest to state that the freshest essay comes from the newest science—sociology—and that it is supplemented by Professor Geddes' paper, which represents the same general outlook. The most striking contribution is that of the Hon. Bertrand Russell, who drives home the problem under review, nothing extenuating in the logical consequences of modern scientific research. One may add, further, that, for American readers, the book can not fail to possess additional suggestiveness because written under British influences. In other words, when more of our scientific men find it possible to write like Sir Oliver Lodge, Professor Arthur Thomson and the Hon. Bertrand Russell, and when more of our religious mentors can speak like the Rev. John Kelman and the Rev. Philip Napier Waggett, we shall be in far better position to 'get together' for the discussion of subjects now agitated or about to be agitated. To render my meaning plainer; I fear that an American botanist, speaking of his Presbyterian brethren, would scarcely find warrant for such a pronouncement as this: "So changing are the times that there seems nowadays to be more independent and speculative thinking among the aspirants to the Scottish ministry, once so strict, than among those of the university faculties of medicine, once and again so comparatively free; at any rate, since Robertson Smith, there has probably been less general ignorance of the results, and even of the methods of scientific research among the students of the older faculty than of the more modern one" (p. 185). Undoubtedly, conditions obtain in the old country that we do not enjoy, for there the *university* attitude, in contradistinction to that of the usual *theological seminary*, exercises much more potent sway over candidates for the ministry. Hence, perhaps, the possibility of such a book as this.

No doubt the work is tentative, not conclusive. No doubt one of the ecclesiastical contributors alludes darkly to a possibile double truth—one for science, another for religion, and a second openly adopts this doctrine, which really evades the entire question at issue. But, even so, the collection remains notable and, as I indicated at the outset, has everything to recommend it to reflective men, no matter on which side of the fence their main presuppositions happen to lie. Moreover, the brilliant criticisms of educational formalism, supplied by Mr. Branford and Professor Geddes, can not fail to set us thinking with reference to some of our own potent, if intangible, academic problems.

R. M. Wenley.

University of Michigan.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Plant World*, the official organ of the Wild Flower Preservation Society of America, now in its seventh volume, will, on January 1, come under the editorial management of Professor Francis E. Lloyd, head of the department of biology in Teachers College.

The Journal of Comparative Neurology and Psychology, for November, has as the leading article a paper of seventy pages entitled, 'The Behavior of *Paramecium:* Additional Features and General Relations,' by H. S. Jennings. On the basis of a summary of previous work on *Paramecium*, experimentally controlled, and a large body of new observations the reactions of this type are critically analyzed and its 'action system' formulated. The discussion of the nature of stimulation and of the reactions of *Paramecium* in detail gives further support to the author's claim that the current theories of tropism need radical revision. The number further contains an editorial by Dr. Yerkes on 'Physiology and Psychology' and a biographical sketch, with portrait and bibliography, of the founder of the journal and late editor-in-chief, Dr. C. L. Herrick.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY.

The December meeting was held at the American Museum of Natural History, Professor Underwood presiding. Papers were presented by Professor H. F. Osborn and Professor F. B. Sumner.

Professor Osborn exhibited newly prepared skulls of *Diplodocus, Morosaurus* and *Creosaurus,* from Wyoming. The skull of *Morosaurus* is new to science.

Under the title 'Recent Discoveries of Extinct Animals in the Rocky Mountain Region and their Bearings on the Present Problems of Evolution,' Professor Osborn exhibited a series of skulls of the Eocene ancestors of the Oligocene Titanotheres, stating as a result of recent investigations that the Oligocene Titanotheres were found to represent four distinct lines of descent in each of which horns independently developed, and that the Eocene forms also represented four distinct lines of descent, two of which became extinct, while the others gave rise to Oligocene forms. As bearing upon the general problem of evolution, it was pointed out that the paleontologist enjoys the peculiar advantage of following a series through the origin and development of organs to their subsequent progression or decline. As early as 1888 the speaker had taken the ground that various paleontological series demonstrate the *definite or determinate variations* of certain kinds. In 1892 he connected with this the idea that certain series of animals related by descent from a common stem form exhibit the *potential of similar evolution,* describing this as a law of latent or potential homology. It is now found in this series of Titanotheres that there is more than a potential of similar evolution; there is evidence of a predisposition to similar evolution as shown in the wholly independent development in two distinct series of horns from hornless types at exactly similar points on the skull, namely, at the lateral junction of the frontals with the nasals. (The communication had been in part presented before the Brooklyn Institute of Arts and Sciences, and before the Zoological Congress at Berne.)

Professor Sumner's paper was a preliminary note on 'Experimental Studies of Elimination and Selective Adaptation in Fishes.' Many experiments with the three common species of *Fundulus* tested the relative effect of asphyxiation and of gradual and abrupt changes of density in transferring from sea to fresh water and *vice versa.* Extended biometric studies point to the following conclusions: (1) the more and the less resisting individuals of a given species are different in type and in variability; (2) different methods of elimination result in selection with reference to different characters; (3) two closely related species were selected with reference to the same characters; (4) *Fundulus heteroclitus* from brackish water differ in all measured characters from those taken from the sea; (5) the differences of type in the three species of *Fundulus* are not due to natural selection acting with reference to the particular conditions which they are fitted to withstand.

M. A. Bigelow,
Secretary.

DISCUSSION AND CORRESPONDENCE.

STYLE IN SCIENTIFIC COMPOSITION.

Professor Eastman has recently (Science, XX., 807) criticized certain new terms in physiography, saying they are not in good taste. This, being interpreted, means that his esthetic judgments are different from those of the inventors of the terms; and I find too that my own judgments have individual peculiarities. Such discordance is surely regrettable; except for the entertainment of his graceful fault-finding we should all be happier if we thrilled or shuddered in unison. But how can harmony be attained? I question the efficacy of ridicule, which tends to strengthen rather than remove prejudices. The late Colonel Ingersoll, who made great use of ridicule, held that it had no power to convince, but could only confirm; and it was a favorite saying that he 'came not to convert sinners, but to comfort the faithful.' Is there not some way in which reason may be brought to bear on the sins of terminology? Is it not possible by discussion to discover or develop principles of scientific nomenclature the establishment of which may make the canons of good taste general instead of personal? I have a suspicion that there are heavy battalions of argument back of Dr. Eastman's skirmish line of assertion; and so venture a few suggestions in the hope of drawing them to the front.

One suggestion is that utility may have an important bearing on our sense of fitness, or even elegance; that there may be a deep philosophic basis for the maxim 'handsome is that handsome does.' Is there not a tendency gradually to adjust esthetic judgments into conformity with rational judgments? Is not expressiveness, after all, the most admirable and the most admired quality of literary composition? And will not the system of technical nomenclature best adapted to practical needs become in the end most grateful to the esthetic sense?

In deprecating the belief of physiographers 'in the penury of the English language, and unsuitability of Saxon epithets,' and in stigmatizing the introduction of 'alien' words, Dr. Eastman seems to oppose the introduction of foreign words for the purposes of scientific terminology. As a large majority of new terms in science are either direct importations or else rearrangements of foreign material, and as the somatic growth of all languages is largely from alien sources, this view is, to say the least, radical, and should not be accepted without good reason. Have I possibly misunderstood him? Or is there a substantial basis for such an opinion?

He objects vigorously to the use of the humanistic analogy, and here I follow him so far as to admit that it has sometimes been carried too far. That is a danger to which all figurative language is exposed, but it is the ordinary danger from excess, and I would not therefore condemn the use of figures. Purely as a matter of literary taste I like the humanistic analogy in Eastman's 'rabble of words recruited from the uttermost parts'; and from the same point of view I like also Davis's characterization of the stages of the topographic cycle in terms of the cycle of human life. Eastman says the physiographic figure is founded on a 'false analogy,' but this I do not admit. The rhetorical quality of good analogy is close resemblance in some striking particular, coupled with difference in other respects; and that is precisely the relation between the topographic and human cycles. The stream valley resembles the human being in that from an early stage it evolves normally through a definite sequence of stages; and in most other respects the two differ.

But the characterization of topographic stages as 'youthful,' 'mature' and 'senile' is not a mere literary flower, the transitory decoration of a sentence; it is a part of technical terminology in continuous employment; and in that capacity its utility is of primary importance. In my judgment there are few groups of terms which serve better than does this group the purpose of concisely expressing an idea. Its strength inheres, first, in the aptness and completeness of the analogy, and, second, in the perfect familiarity of the group of facts to which the unfamiliar facts are likened. The physiographic stages have no precise limits, but grade one into another as parts of a continuous development; each one is so complex in its phenomena and so variable from individual to individual that sharp-cut definition is impossible; and in these respects they are strictly paralleled by the life stages. The aptness and the familiarity make the terms permanently mnemonic, so that the use of any one of them brings to mind not only the sequence, but relative position within the sequence. Davis's generalization had such merit that it would probably have found eventual appreciation, whatever its mode of expression, but I think that the promptness and universality of its acceptance and assimilation were in large measure due to the felicity of the associated terminology.

G. K. GILBERT.

WASHINGTON, D. C.

L'ANNÉE BIOLOGIQUE.

TO THE EDITOR OF SCIENCE: We learn that the annual *L'Année biologique* is in danger of being discontinued unless it receives additional support. One hundred more subscribers in this country would probably encourage the editors to go on with it. These ought not to be difficult to get. To those who are unacquainted with it we may say that it is quite unique and occupies a different and higher plane than most bibliographic works. There is not merely a more or less roughly classified list of titles and brief abstracts of contents, but a series of logically arranged *critical* reviews pointing out the bearing of the paper, reviewed on the state of knowledge of the subject. The systems of cross referencing and indexing are wonderfully complete. The reviews are arranged primarily into twenty chapters, as follows: Cell, sex products and fertilization, parthenogenesis, asexual reproduction, ontogenesis, teratogenesis, regeneration, grafting, sex and pleomorphism, alternation of generations, latent characters, correlation, death, general morphology and physiology, heredity, variation, origin of species and specific characters, geographic distribution, nervous system and functions, general theories. Most of these chapters are elaborately subdivided. A feature has been comprehensive reports on the state of our knowledge of special topics. No one who is interested in the development of the topics named above can view with equanimity the prospect of the loss of this review. It is to be hoped that every biological laboratory and every library that has a scientific department and which lacks *L'Année biologique* will at once send a subscription to Schleicher frères, Paris, the publishers, or to Professor Y. Delage, Sorbonne, Paris, the chief editor.

Chas. B. Davenport,
Jacques Loeb.

THE EPIDIASCOPE.

To the Editor of Science: Who saw the epidiascope at the St. Louis Exposition? It appears in the catalogue of German scientific instruments at page 211, and is a most interesting type of projection apparatus, of especial utility to all schools. The possibility of speedy and facile transition from reflected to transmitted light, if worked out to the last optical and mechanical detail, would render it worthy of wide adoption. The diffusion of knowledge of all the arts and sciences ought to be very materially enhanced by this perfected apparatus. The projection of printed pages, photographs, charts and works of art, all without the necessity of photography, is most important. The name of the inventor is not given: presumably Carl Zeiss, of Jena.

David P. Todd.

Amherst College Observatory.

SPECIAL ARTICLES.

THE INFLUENCE OF CAVERNS ON TOPOGRAPHY.

It is well known that caverns, particularly those in regions underlain by limestone, are frequently associated with depressions in the surface above them, such as sink-holes, or swallow-holes, as they are commonly termed. It is also a familiar fact that the falling of portions of the roofs of caverns sometimes gives origin to ravines, canyons, etc., which are occasionally spanned by remnants of the roofs which remain in place, as in the case of the natural bridge of Virginia, and in other similar ways influence surface relief. A characteristic feature of this class of topographic changes is that depressions in the surface of the land are produced. The class of land forms to which attention is here invited, however, are exceptional, and, as it seems, have not been recognized as having a direct association with caverns, for the reason that they stand in relief and in some instances are conspicuous and picturesque on account of their height and boldness.

The topography of most regions the world over owes its leading characteristics, aside from elevation above the sea, to erosion. The chief exceptions are elevations produced by volcanic and glacial deposition. Erosion, particularly by streams, leads to the production of two classes of earth features, one class being due to the removal of material, as in the excavation of valleys, while the other class includes the remnants of uplands left when erosion to a plane surface is incomplete. In the production of such topographic changes, weak rocks, as a rule, are removed most readily and are replaced by depressions; while resistant rocks persist longer and are left in relief.

By weak rocks is meant those which offer a comparatively small degree of resistance to the agencies of abrasion, such as streams, glaciers, etc., or yield readily to the solvent action of water; while resistant rocks are such as have the opposite attributes in these particulars. Certain rocks are weak in reference to both mechanical and chemical erosion; and of the members of this class limestone is by far the most common.

On account of its comparative softness and solubility, limestone is, as a rule, more easily removed during the process of denudation than the formations with which it is usually associated, and when it occurs at the earth's surface side by side with more resistant rocks, its presence is frequently indicated by a depression. So generally is this the case, particularly if the rocks referred to occur in essentially horizontal beds, that it is a surprise to find limestone forming bold eminences in a region which has been stable for a long time and in which pronounced mechanical and chemical denudation has occurred. Examples of limestone standing in bold relief in regions where, for the most part, these several conditions obtain, are furnished by Mackinac Island, situated in the western portion of Lake Huron, and by Gibraltar, the well-known rock-fortress, one of the Pillars of Hercules.

Mackinac Island has a circumference of about nine miles, and an area of 2,221 acres. It rises to an elevation of 317 feet above the level of Lake Huron, and the surrounding water within a mile of its shore is from 150 to 200 feet deep; its total height above the bottom of the partially submerged valley in which it is situated is thus in excess of 500 feet. The rock of which the island is composed is limestone, which dips very gently to the south, and at several localities has been eroded so as to form vertical lake-cliffs. Limestone belonging to the same geological formation occurs on the neighboring St. Ignace Peninsula, but excepting these two circumscribed localities, has been deeply denuded over an extensive region, and the depressions formed are now occupied by the waters of Lakes Huron and Michigan.

Gibraltar rises 1,349 feet above the surface of the Mediterranean, and the water within a mile of the borders of the peninsula is from 300 to more than 600 feet deep. The length of the promontory is about two and one half miles and its width from 550 to 1,550 yards.* It is composed mainly of limestone in highly inclined strata, and, as is rendered evident from its isolated position and the presence of similar limestone on the African side of the adjacent strait, is a remnant of a once extensive formation.

Mackinac Island and Gibraltar are similar in several particulars; for example, each one is situated on the border of a navigable strait, and is of great strategic importance, as history has demonstrated; but a more fundamental fact is that they are composed mainly of fissured and cavernous and in part brecciated limestone, which is thus rendered especially favorable for the downward percolation of water. The only conspicuous difference between the two elevations seems to be that the rock of Mackinac Island is essentially horizontal, while the rock of Gibraltar is steeply inclined. In each case bordering precipices are present which, no doubt, have been produced in part by under-cutting by waves and currents, but the isolation of the great rock masses themselves seems to be due to the lowering of the region about them respectively, and this lowering, as it seems most reasonable to conclude, has resulted from subaerial denudation. Precisely why bold remnants of formerly widely extended formations should have been left at these two localities, however, has, so far as I am aware, never been explained.

Another example of limestone standing in relief in a deeply denuded region, and one which is especially instructive in the above connection, is furnished by a low hill at

* A. C. Ramsy, and James Geikie, 'On the Geology of Gibraltar,' in *Quarterly Journal of the Geological Society of London*, Vol. XXXIV., 1878, pp. 505–541.

I should, perhaps, state in partial justification for presenting the present article, that I have visited each of the localities mentioned above, and have at least some first-hand information concerning them.

Luray, Va. The hill referred to has extensive caverns beneath it, and, as appears evident, has been left in relief owing to the more rapid denudation of the surrounding country; the reason being that rain falling on the area where the rock is cavernous percolated downward and was prevented from forming surface streams and in consequence lost its ability to mechanically erode, while the surrounding country where the existence of surface streams was possible was degraded more rapidly.

The influence of subterranean drainage, as must be well known although seldom mentioned, is frequently indicated by minor elevations, especially in limestone regions where joints and other openings permit of the ready descent of surface water. Similar conditions on a larger scale, as just stated, may reasonably be held accountable for the origin of the hill above the caverns at Luray, and seemingly furnish the basis for an hypothesis which meets the conditions present at Mackinac Island and Gibraltar. If this hypothesis is sustained by future tests, it not only furnishes an explanation of the origin of the elevations just mentioned, but embodies a principle which is widely applicable. For example, it is frequently stated in modern text-books of physical geography, that residual hills standing on plains of subaerial denudation or 'monadnocks,' owe their prominence to the greater resistance of the rocks of which they are composed, mainly because of their hardness, in comparison with the rocks about them; or have been spared on account of their geographical position, that is, they occur at localities where streams originated and flowed away in various directions, and in consequence were left in relief after the country about them had been conspicuously degraded. To these explanations of the origin of monadnocks a third may now be added, namely: If the rocks of a given area are more open and porous, or traversed by fissures or caverns to a conspicuously greater degree than the rocks beneath the surrounding region—the general elevation being sufficient to favor subterranean drainage—they may be left in relief because the water reaching them will be conducted away by means of underground channels and thus in a great measure and in general almost entirely deprived of its power to mechanically erode, while adjacent areas are not favored in this manner.

A consideration of all the known facts relating to the rocky heights forming Mackinac Island and Gibraltar indicates that at each of these localities a residual of the nature of a monadnock has been left as the region about it was lowered by erosion; the controlling condition being that the rocks left in relief are fissured and cavernous, thus facilitating subterranean drainage, while the country about them was denuded at a more rapid rate through the agency of surface streams.

Israel C. Russell.
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A NOTABLE ADVANCE IN THE THEORY OF CORRELATION.

To Professor Karl Pearson the new science of biometry is indebted not only for its name, but also for those refinements and extensions of the methods of statistical analysis without which it would be far from occupying the position which it holds to-day. In the remarkable series of memoirs which have appeared under the general title 'Mathematical Contributions to the Theory of Evolution,' Pearson and his assistants have laid a foundation on which a superstructure of great import to biology can, and will be, reared. The most recent of the memoirs in this series* brings forth a very interesting extension of the theory of correlation which at once greatly widens the range of problems and material which can be effectively handled by biometric methods.

In the development of the method of determining the degree of correlation between characters not admitting of quantitative measurement,† it was thought necessary in forming the correlation table to arrange the classes

* 'Mathematical Contributions to the Theory of Evolution,' XIII. 'On the Theory of Contingency and its Relation to Association and Normal Correlation.' Drapers' Company Research Memoirs, Biometric Series, I., pp. 1–35, 2 pl., 1904.

† *Phil. Trans.*, Vol. 195 A, pp. 1–47, and pp. 79–160.

or subgroups of the characters in a definite order corresponding to the real (though in detail undeterminable) quantitative scale in the character or attribute itself. The order of the classes appeared to be the important thing, and consequently the method was assumed to be limited to such attributes as could be arranged in a definite scale order. In recent work, however, by varying the order of the classes Pearson has found that so far as the value of the correlation coefficient is concerned this group order has practically no influence. For the new conception of correlation which arose from a consideration of this fact Pearson proposes the term *contingency.*

As a measure of the *contingency* of any classification of characters, it is proposed to use some measure of the 'total deviation of the classification from independent probability.' The practical method of making such a measure Pearson develops in the following way.

"Let A be any attribute or character and let it be classified into the groups A_1, A_2, $\cdots$, A_s, and let the total number of individuals examined be N, and let the numbers which fall into these groups be n_1, n_2, $\cdots$, n_s, respectively. Then the probability of an individual falling into one or the other of these groups is given by n_1/N, n_2/N, $\cdots$, n_s/N, respectively. Now suppose the same population to be classified by another attribute into the groups B_1, B_2, $\cdots$, B_t, and the group frequencies of the N individuals to be m_1, m_2, $\cdots$, m_t, respectively. The probability of an individual falling into these groups will be respectively m_1/N, m_2/N, m_3/N, $\cdots$, m_t/N. Accordingly the number of combinations of B_v with A^n to be expected on the theory of independent probability if N pairs of attributes are examined is

$$N\times\frac{n_u}{N}\times\frac{m_v}{N}=\frac{n_u m_v}{N}=\nu_{uv}, \text{ say.}$$

"Let the number actually observed be n_{uv}. Then, allowing for the errors of random sampling,

$$n_{uv}-\frac{n_u m_v}{N}=n_{uv}-\nu_{uv}$$

is the deviation from independent probability in the occurrence of the groups A_u, B_v. Clearly the total deviation of the whole classification system from independent probability must be some function of the $n_{uv}-\nu^n_v$ quantities for the whole table." The value of any function of these quantities will clearly be independent of the order of classification.

The following functions of the $n_{uv}-\nu_{uv}$ quantities were chosen for practical use.

(*a*) $1-P$; the *contingency grade,* where P is determined from χ^2 by the use of Elderton's tables.* The quantity χ^2 is a measure of the deviation of the observed results from independent probability, depending on the $n_{uv}-\nu_{uv}$ quantities as shown by the equation

$$\chi^2=S\left\{\frac{(n_{uv}-\nu_{uv})^2}{\nu_{uv}}\right\},$$

where S indicates summation of like quantities over the whole table. A large value for $1-P$ indicates that there is association between the attributes, while with a small value of this function the chances are that the system arose from independent probability.

(*b*) The function

$$\phi^2=\frac{\chi^2}{N};$$

termed the *mean square contingency.*

(*c*) The function

$$\psi=\Sigma\frac{(n_{uv}-\nu_{uv})}{N};$$

where Σ denotes summation of all $n_{uv}-\nu_{uv}$ quantities *having the same sign.* This function ψ is called the *mean contingency.*

In determining the functions of ϕ^2 and ψ which shall be used practically, Pearson considers the relation of these quantities in the case of normal correlation. After some analysis the result is reached that

$$\phi^2=\frac{r^2}{1-r^2},$$

or

$$r=\pm\sqrt{\frac{\phi^2}{1+\phi^2}}$$

in the case of normal correlation. This result proves at once that 'the coefficient of correlation is * * * entirely independent of the arrangement of our classes on the basis of any assumed order or scale.'

* *Biometrika*, Vol. I., p. 155.

This function

$$\sqrt{\frac{\phi^2}{1+\phi^2}}$$

is called the *first coefficient of contingency* and is denoted by C_1.

The analysis of the relation of function ψ in the case of normal correlation leads to the practical result that the value of r may be obtained if ψ is given, which, of course, is the case, the latter function being obtained from the observations. A table and plotted curve from which values of r correct to two places may be read off directly, are given. If the coefficient so obtained from ψ be designated as C_2 the *second coefficient of contingency,* we have as a *limiting case*

$$C_1 = C_2 = r$$

when the correlation is normal and the grouping is sufficiently fine. The approach of C_1 and C_2 to equality may be taken as a measure of the approach of the system to normality and of the correctness of the grouping.

An investigation into the problem of the probable errors of contingency coefficients leads to the result that the probable error of any contingency coefficient C may, for rough judgments, safely be taken to be less than

$$2 \times .67449 \frac{1-C^2}{\sqrt{n}}.$$

The percentage probable error of

$$\phi^2 = \frac{1.34898}{\sqrt{N}} \sqrt{\frac{1+\phi^2}{\phi^2}}.$$

After considering the subject of multiple contingency and its relation to multiple normal correlation the author proceeds to give some illustrative examples showing something of the sort of problems to which the method may be applied, and also how it is to be used in practise. The examples include (*a*) the correlation between father and son in respect to stature, (*b*) color inheritance in greyhounds, (*c*) fraternal resemblance in hair color in man, and (*d*) the correlation between father and son in respect to occupation or profession.

The net results brought out by the analysis and confirmed by the numerical illustrations may best be stated in the author's own words: "With normal frequency distributions both contingency coefficients pass with sufficiently fine grouping into the well-known correlation coefficient. Since, however, the contingency is independent of the order of grouping, we conclude that, when we are dealing with alternative and exclusive sub-attributes, we need not insist on the importance of any particular order or scale for the arrangement of the subgroups. This conception can be extended from normal correlation to any distribution with linear regression; small changes (*i. e.,* such that the sum of their squares may be neglected as compared with the squares of mean or standard deviation) may be made in the order of grouping without affecting the correlation coefficient." These results "are not so fruitful for practical working as might at first sight appear, for they depend in practise on the legitimacy of replacing finite integrals by sums over a series of varying areas, where no quadrature formula is available. If we, to meet the difficulty, make a very great number of small classes, the calculation, especially of the mean square contingency, becomes excessively laborious. Further, since in observation individuals go by units, casual individuals, which may fairly represent the frequency of a considerable area, will be found on some one or other isolated small area, and thus increase out of all proportion the contingency. The like difficulty occurs when we deal with outlying individuals in the case of frequency curves, only it is immensely exaggerated in the case of frequency surfaces. It is thus not desirable in actual practise to take too many or too fine subgroupings. It is found, under these conditions, that the correlation coefficient as determined by the product moment or fourfold division methods is approximated to more closely in the case of the contingency coefficient found from mean square contingency than in the case of that found from mean contingency. Probably 16 to 25 contingency subgroups will give fairly good results in the case of mean square contingency, but for each particular type of investigation it appears desirable to check the number of groups proper for the purpose by comparing with the results of test fourfold division correlations. Under such conditions it appears likely that very steady and consistent results will be obtained from mean square contingency."

In the calculation of contingency coefficients the present writer has found that the following procedure saves much time and labor. The value of the independent probability ν_{uv} for each compartment of the table is obtained by the use of a Thacher calculating instrument (Keuffel and Esser). With this instrument one can read directly to four or five figures the values of any expression which can be put into the form ax/b, where a and b are constants and x is a variable. Since ν_{uv} for any compartment equals $(n_u \cdot m_u)/N$ for that compartment, it is evident that by taking either n_u or m_v as the constant, it will only be necessary to make as many settings of the instrument as there are rows or columns in the table. Having obtained the ν_{uv} quantities, the sub-contingencies $(n_{uv} - \nu_{uv})$ may be written down directly, squared from Barlow's tables, and divided by ν_{uv} with an arithmometer or with Zimmermann's or Crelle's multiplication tables. The remainder of the calculations necessary to obtain the mean square contingency and the whole of the calculations for the mean contingency, and their respective coefficients are, of course, easily performed. Proceeding in this way, the calculation of contingency coefficients, even though several experimental groupings are made, has been found to take but comparatively little time.

The noteworthy features of this method of contingency are found in that it, in the first place, broadens and illumines the whole theory of correlation, and in the second place, brings within the range of biometrical investigation a large series of problems to which it has hitherto been impossible to apply exact methods. One can but feel that this memoir, like so many of the others which have preceded it in the series, marks a definite and fundamental step in advance in the steady progress of the science of biometry.

Raymond Pearl.

'GLUCINUM' OR 'BERYLLIUM.'

Some years ago the question of choice between the two names 'glucinum' and 'beryllium' was gone into quite carefully by Professor F. W. Clarke and also by the committee appointed by the American Association on the Spelling and Pronunciation of Chemical Terms, and the conclusion was arrived at that the name 'glucinum' should be used on the ground of priority. In Science for December 9 Dr. Charles Lathrop Parsons has stated his grounds for preferring the name 'beryllium.' Dr. Parsons is, thanks to his bibliographical work on the element in question, thoroughly informed in its literature, but the arguments adduced by him would seem to lead to a conclusion diametrically opposed to that which he has drawn.

It was obviously the privilege of Vauquelin, the discoverer of the element, or rather its oxid, to name it. This he never did, but contented himself by speaking of it at first as 'la terre du Béril,' that is, the earth in beryl. At the close of Vauquelin's first paper the editors of the *Annales* added a note signed 'Redacteur' in which they propose the name 'glucine.' It was of course well known that Guyton and Fourcroy were the editors. Vauquelin's second paper in the *Annales* was evidently prepared at the same time as the first, or at least before the second was in print. In his third paper, some weeks later, as Dr. Parsons admits, Vauquelin actually adopted the term 'glucine,' prefacing its use with 'on a donné le nom de glucine.' The paper in the *Journal des Mines* was apparently prepared at the same time as the first two papers in the *Annales* and before the appearance of the suggestion of Guyton and Fourcroy, but at its close occurs the note which Dr. Parsons has quoted. In this he states that Guyton and Fourcroy have advised him to call the new earth 'glucine' and while he evidently does not think the name the best that could have been chosen, he clearly acquiesces in the suggestion of the two great authorities and says 'Cette denomination sera assez significante pour aide le mémoire.' Finally, as seen above, in his third paper, he adopts the name. As far as priority goes, the argument in favor of 'beryllium' would seem to be that probably Vauquelin would have given the earth some other name had he ventured to dissent from

Guyton's authority, and it is probable that he would have liked to name it 'beryllia.' All of which may be quite true, but actually he did not do it.

As regards the German use of 'Berylerde' it was merely at first the natural translation of Vauquelin's expression 'la terre du Béril,' which, as we have seen, he used in no denominative sense. If the generally accepted rules of priority have any weight 'glucinum' is the only term to be used for the element.

As regards usage, the case is hardly quite as bad as Dr. Parsons seems to think, since the index to the *Journal of the Chemical Society* (London) for 1903 gives 'Beryllium, see glucinum.' With French, English and Americans using 'glucinum,' we can afford to let the German journals cling to 'beryllium' a little while longer.

Incidentally, what shall we do when the Germans insist on kalzium, kolumbium, karolinum, zerium and zesium, or will it be kæsium?

Jas. Lewis Howe.

Washington and Lee University,
December 12, 1904.

BOTANICAL NOTES.

THE STUDY OF FIBERS.

The book ('The Textile Fibers, their Physical, Microscopical and Chemical Properties') prepared by Dr. J. M. Mathews, and recently published by John Wiley, should make the study of textile fibers somewhat easier by students and practical operators. It covers nearly three hundred pages of neatly printed text, illustrated by sixty-nine cuts, in which the author has presented the whole matter in a most helpful way. There is first a useful classification of fibers, followed by descriptions and discussions of those which enter into fabrics. Some of these fibers are, of course, of animal origin, as wool, hair and silk, and to these are given about ninety pages. The remainder of the book is devoted almost wholly to plant fibers, and here the treatment is especially clear and helpful. The origin, varieties, physical and chemical properties of cotton, and mercerized cotton, are discussed in as many chapters. Linen is given another chapter, while jute, ramie, hemp and several other fibers of minor importance are disposed of in another chapter. An interesting chapter for the general reader is the one on artificial silks, the processes for the production of which 'have been attended with a considerable degree of success.' It is said that artificial silk 'has become a commercial article, and is used in considerable quantity by the textile trade.' Of these artificial silks there are four general kinds, viz:

1. Pyrozylin silks, made from a solution of gun cotton in a mixture of alcohol and ether.

2. Fibers made from a solution of cellulose in ammoniacal copper oxide or chloride of zinc.

3. Viscose silk, made from a solution of cellulose thiocarbonate.

4. Gelatin silk, made from filaments of gelatin rendered insoluble by treatment with formaldehyde.

Most of the artificial silk is of the first variety, the manufacture of which is carried on in England, Germany, France and Switzerland. "The fibers are formed by forcing the ether-alcohol solution of pyroxylin through glass capillary tubes, and winding them on frames. As the solution is very viscous it requires a pressure of forty-five atmospheres to discharge it through the capillary openings."

A STUDY OF COMPARATIVE EMBRYOLOGY.

The comparative embryology of the *Cucurbitaceae* (Gourd Family) has been studied by Dr. J. E. Kirkwood, the results of which appear in the *Bulletin of the New York Botanical Garden* (No. 11, 1904). After an instructive historical introduction, the organogeny of representatives of the five tribes (*Fevilleae, Melothrieae, Cucurbiteae, Sicyoideae,* and *Cyclanthereae*) is summarily described, and this is followed by a quite particular examination of the embryo-sac in sixteen genera distributed among the five tribes. Twelve fine plates of 166 figures add much to the value of this portion of the paper. In a closing discussion the author finally concludes that 'in most points the differences between the *Cucurbitaceae*, and other sympetalous families are more striking than the similarities.' The paper closes with a bibliography including 89 titles. It constitutes a valuable addition to our knowledge of the embryology of a family whose place in the system of plants is still in doubt.

A HELPFUL BULLETIN.

THE office of experiment stations of the United States Department of Agriculture has issued a bulletin (No. 2) consisting of an outline of a lecture on 'Potato Diseases and their Treatment,' for the use of farmers' institute lecturers. It was prepared by F. C. Stewart and H. J. Eustace, of the New York Experiment Station. It contains summaries of our knowledge of the most important diseases which affect the potato in the United States. The descriptions are given in nontechnical language, and ought to convince every botanist of the possibility of treating quite difficult subjects in plain English. Following the description of diseases, is an admirable chapter on spraying and other preventive measures. A very useful bibliography is added in an appendix.

CHARLES E. BESSEY.
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THE NOBEL PRIZES.

IN a cablegram from Stockholm to the London *Times,* dated December 10, further details are given in regard to the Nobel prizes.

The prize for physics has been awarded to Lord Rayleigh, professor of natural philosophy at the Royal Institute. The chemistry prize is conferred upon Sir William Ramsay, professor of chemistry at University College. M. Pavloff, professor at the Military Academy of Medicine at St. Petersburg, receives the prize for physiology and medicine. The literature prize is divided between M. Mistral, the Provençal poet, and Don Jose Echegaray, the Spanish dramatist. The peace prize has been awarded to the Institute of International Law.

The distribution of the Nobel prizes took place in the great hall of the Academy of Music at Stockholm in the presence of King Oscar. Lord Rayleigh, Professor Ramsay and M. Pavloff received their prizes, together with diplomas and gold medals, in person from his Majesty, while the prizes awarded to M. Mistral and Don Jose Echegaray, who were unable to be present, were handed to the French and Spanish ministers respectively. The sum of money attaching to each prize amounts to 140,858 kroner (about $39,000). The Nobel peace prize will be presented by the Norwegian Storthing at Christiania.

The distribution of the prizes was followed by a banquet at the Grand Hotel. Covers were laid for 190 guests, the company including the Crown Prince, Prince and Princess Charles, Lord and Lady Rayleigh, Sir William and Lady Ramsay and M. and Mme. Pavloff. Count Mörner, speaking in German, proposed the health of M. Pavloff; Professor Petterson, in English, proposed the health of Sir William Ramsay; and Professor Hasselberg, in Latin, that of Lord Rayleigh.

SCIENTIFIC NOTES AND NEWS.

AT the meeting of the American Association for the Advancement of Science held at Philadelphia last week, Professor C. M. Woodward, of Washington University, was elected president for the New Orleans meeting.

AT the recent Philadelphia meeting of the American Society of Naturalists, Professor William James, of Harvard University, was elected president. Professor Chas. B. Davenport, of the Cold Spring Laboratory of Experimental Evolution of the Carnegie Institution, and Professor J. M. Coulter, of the University of Chicago, were elected vice-presidents, and Professor W. E. Castle, of Harvard University, secretary.

PROFESSOR MARY WHITON Calkins of Wellesley College, has been elected president and Mr. Wm. Harper Davis, of Lehigh University, secretary, of the American Psychological Association.

PROFESSOR JOHN DEWEY, of Columbia University, has been elected president of the American Philosophical Association.

PROFESSOR S. W. BURNHAM, astronomer at the Yerkes Observatory, has been awarded the Lalande gold medal of the French Academy of Sciences for his researches in astronomy.

PROFESSOR SVANTE ARRHENIUS has been made head of a laboratory for physical chemistry, to be established at Stockholm by the Nobel Institute.

Professor E. E. Barnard, of Yerkes Observatory, will join Professor George E. Hale at the branch of the observatory on Mt. Wilson, Cal. He will take with him the Bruce 10-inch photographic telescope and will spend the rest of the winter and next summer in making photographs of the sun.

M. Vieille has been elected a member of the Paris Academy of Sciences in the Section of Mechanics, and M. Dastre a member in the Section of Medicine and Surgery.

Professor Tanmann, of Göttingen, has received from the German Society of Engineers the sum of 5,000 Marks for experiments on the melting point of alloys.

The superintendent of government laboratories for the Philippines, Dr. Paul C. Freer, formerly professor of chemistry at the University of Michigan, is at present in the United States on a leave of absence.

Mr. George V. Nash and Mr. Norman Taylor returned late in December to the New York Botanical Garden from an exploring tour around the island of Inagua in the Bahamas. The expedition secured a valuable collection of living and preserved plants, including many massive specimens of the few cacti native to the island.

Dr. C. Hart Merriam, chief of the Biological Survey of the Department of Agriculture, lectured at Stanford University on December 15. He has since returned to Washington.

Mr. Charles F. Lummis, of Los Angeles, Cal., lectured before the New York Society of the Archeological Institute of America on December 22, his subject being 'The Primitive Music of the Southwest.'

Lord Rayleigh delivered a lecture at the Academy of Sciences, Stockholm, on December 13, on 'The Density of Gases.'

A window in the cathedral at Norwich in memory of the late William Cadge, an eminent surgeon of the city, was unveiled on December 6, by the president of the Royal College of Surgeons.

Mr. Eugene G. Blackford, of Brooklyn, a fish merchant who made many contributions to ichthyology and did much to promote its study, died on December 28, at the age of sixty-five years.

Mr. Francis H. Nicholas, a newspaper correspondent of New York City, has died in Tibet, where he was making explorations.

We regret also to record the deaths of M. Bernard Renault, assistant in paleontology in the Paris Museum of Natural History, at the age of sixty-eight years; of Dr. I. N. Goroschankin, professor of botany at Moscow at the age of sixty years; of M. André Lefèvre, professor of ethnology at Paris School of Anthropology at the age of seventy years, and of Dr. Karl Koester, professor of pathology at Bonn.

Mr. Robert H. Sayre, president of the Board of Trustees of Lehigh University, has presented the institution with an annex to the Sayre Observatory founded by him in 1860. The building, designed by Professor C. L. Thornburg, contains a zenith telescope, made by Warner and Swasey and presented to the university by Mr. Sayre.

One of the most valuable contributions of scientific material yet made to the New York Botanical Garden has recently been received from Sir William Dyer, director of the Royal Gardens at Kew, England, consisting of many thousand herbarium and museum specimens of lichens, duplicates from the famous lichen herbarium formed by the Rev. W. A. Leighton, of Luciefelde, Shrewsbury, and presented by him to the Royal Gardens in 1882.

The *British Medical Journal* states that at a sitting of the Paris Académie de Medécine held on December 14 the names of the successful candidates for the various prizes offered for medical researches of one kind or another were announced. The Audiffred prize of £960 for the best work on tuberculosis was not awarded, but sums varying from £60 to £20 were given, by way of encouragement, to Dr. Armand Delille, of Paris, for an investigation of the part played by the poisons generated by Koch's bacillus in tuberculous meningitis and tuberculosis of the nerve centers; to Dr. Nattan-Laurier, of Paris, for a research on mammary tuberculosis; to Dr. Pautrier, of Paris, for one on atypical forms of cutaneous tuberculosis; and to Dr. Lalesque, of Arachon, for a memoir on the sea and consumptives. The Baillarger prize for £80 for researches on mental diseases was awarded to Dr. Paul Sérieux for a series of reports on the treatment of insanity and the organization of asylums. The Adrien-Buisson prize of £420 was awarded to MM. E. Leclainche, professor in the Veterinary School of Toulouse, and H. Vallée, professor in the Veterinary School of Alfort, for researches on symptomatic anthrax and gangrenous septicæmia. The Campbell-Dupierris prize of £92 was awarded to Dr. J. Tissot, of Paris, for an experimental investigation on the exchange of gases in the arterial blood, the ventilation of the lungs, and arterial pressure during chloroform anæsthesia. The Daudet prize of £40 was awarded to Professor Monprofit of Angers for a memoir on tumors; to the same surgeon also fell the Huguier surgical prize of £120 for essays on the surgery of the ovaries and Fallopian tubes, and on salpingitis and ovaritis. The Theodore Herpin (de Genève) prize of £120 was awarded to Drs. P. E. Launois and Pierre Roy, of Paris, for a biological study of giants. The Jacquemier obstetrical prize of £68 was awarded to Dr. Bouchacourt, of Paris, for a series of memoirs on the applications of radiography to midwifery; while Dr. Briquet, of Nancy, gained the Tarnier prize of £120 for a work on tumors of the placenta. The Laborie surgical prize of £120 was awarded to Drs. J. Hennequy and R. Loewy, of Paris, for a monograph on the treatment of fractures of the long bones. The Louis prize of £120 was awarded to Dr. Victor Balthazar, of Paris, for a memoir on the serumtherapy of typhoid fever, and the Saintour prize of £172 to Drs. Fernand Bezançon and Marcel Labbé for a treatise on hæmatology. A considerable number of prizes of smaller value was awarded to various competitors.

WE learn from the *British Medical Journal* that Professor Koch expected to start on a new expedition of scientific exploration on December 17. He will first proceed to Dar es Salam in German West Africa for the purpose of completing the researches on cattle plague begun by him in South Africa. These investigations were directed to purely practical objects, while questions of importance from the scientific point of view had to be left untouched. These questions will now in the first instance engage Professor Koch's attention, but he will also study other tropical diseases affecting animals and man. As occasion arises he will go to other places suitable for purposes of research. Professor Koch estimates that he will be away six months. On December 11 a dinner was given by a committee formed to celebrate the completion of his sixtieth year.

THE report of the Meteorological Council for the year ending March 31, 1904, to the president and council of the Royal Society has been issued as a Blue-book. According to an abstract in the London *Times* it is stated at the outset that a meeting of the International Meteorological Committee was held at Southport during the session of the British Association at that place. Among the subjects then raised was the very important question of the units adopted in different countries for meteorological measurements. In the United Kingdom, its colonies and dependencies, and in the United States the inch and the Fahrenheit degree have always been used for the measurement of pressure and temperature, whereas in the rest of the world the millimeter and the centigrade degree have been adopted. The council state that if they can obtain a satisfactory consensus of opinion as to the method of measurement which will probably commend itself to the approval of all civilized countries, they are prepared to give effect to proposals for the adoption of that method in this country without delay. After discussing other matters dealt with by the international committee, such as the report of the sub-committee on cloud observations and the relation between solar and terrestrial changes, the council proceed to state that the office has been in communication with the Deutsche-Seewarte and the Meteorological Institute of the Netherlands with regard to the 7 A.M. service of telegraphic reports. In order to obtain reports at that hour from the east coast of England, a special station was established at Skegness. Reports have also been obtained from Portland Bill, and Malin Head has taken the place of Blacksod Point. A station was still required, however, on the south coast of Ireland to complete the requirements of the two continental offices. In other respects the arrangements for weather telegrams between this country and the continent of Europe, the Azores and the United States remained the same as in the preceding year. The council regret that the practical extension of wireless telegraphy has not enabled them to increase the area of observation to the westward by information obtained from Atlantic liners by that means.

UNIVERSITY AND EDUCATIONAL NEWS.

Lord Rayleigh proposes to present to Cambridge University the value of the Nobel prize for physics which has just been awarded to him.

The secretary of the University College of North Wales has announced that the recent bequest to the college by the late Dr. Isaac Roberts, the astronomer, is expected to realize £15,000.

The University of Edinburgh has received a gift of £25,000 from Sir Donald Currie for the establishment of lectureships. £5,000 may, however, be used for the purchase of a site for new laboratories. The university has also received £15,000 from other sources.

In accordance with the will of George Smith, '53, of St. Louis, filed in March, 1902, the treasurer of Harvard University has received in cash and securities a payment of $257,550.66. When this fund reaches $450,000 by accumulation, three new dormitories are to be erected. They will be named the James Smith Hall, the Persis Smith Hall, and the George Smith Hall.

It is reported that general plans for the new Yale library to be built from the Ross legacy of $250,000 are definitely settled. The Chittendon wing will be preserved, and the first part of the new library will probably be built between that wing and the present old university library, which will thus be preserved for some years. The new structure will probably use up the whole legacy of $250,000, and will supply all university library needs for twenty-five years to come.

Hollis Hall, the oldest dormitory of Harvard University in use, was damaged by fire to the extent of $5,000 on December 29.

The Columbia University Council has authorized the degree of graduate in pharmacy to be conferred, as in the past, by the New York College of Pharmacy, but has provided for the establishment of a course of higher grade leading to the degree of pharmaceutical chemist.

A school of veterinary medicine and surgery was opened at the University of Liverpool on December 13.

The Association of American Universities will meet at Johns Hopkins University, in Baltimore, on January 12, 13 and 14. The following are the delegates: California, Professor B. I. Wheeler, Professor Irving Stringham, Professor Leuschner; Catholic, Dr. E. A. Pace, Dr. M. F. Egan; Chicago, President W. R. Harper, Professor A. W. Small; Clark, President G. S. Hall; Columbia, Professor Monroe Smith, Professor W. H. Carpenter, Professor Henry M. Howe, Professor E. D. Perry, Mr. F. P. Keppel; Cornell, Dean Thomas F. Crane; Harvard, President C. W. Eliot, Dean J. B. Ames, Professor T. N. Carver; Johns Hopkins, President Remsen, Professor Gildersleeve, Professor Welch; Leland Stanford, Jr., Professor A. H. Suzzallo, Professor E. P. Cubberley; Michigan, Professor A. C. McLaughlin; Pennsylvania, Dean J. H. Penniman, Professor J. C. Rolfe, Dean Clarence G. Childs; Princeton, Professor A. F. West, Professor W. M. Daniels, Professor H. B. Pine; Virginia, Dean J. M. Page, President E. A. Alderman; Wisconsin, President Charles R. van Hise; Yale, President A. T. Hadley.

John Robert Sim, assistant professor of mathematics in the College of the City of New York, has been made head of the department of pure mathematics.

Dr. Oskar Brefeld, professor of botany at Breslau, has retired from active service.

SCIENCE

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SCIENCE

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FRIDAY, JANUARY 13, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*ACADEMIC IDEALS.**

THE beginning of an academic year calls up at once the lighter thoughts of pleasing associations and the graver thoughts of inspiring obligations. Here on the tableland of intellectual life youth and age meet to labor for a season in the fields of knowledge and discovery. The confident optimism of youth seeks to be chastened by the gentle admonition of experience. Youth imparts its buoyancy to age, age imparts its wisdom to youth, and both are kindled by the glow of elevating aspirations. It is a time, therefore, for a blending of our lighter and our graver reflections.

Being delegated for the moment to speak to and for this academic body, it has seemed that some considerations on academic ideals might serve to awaken thought and to arouse zeal appropriate to the occasion. In the abstract, however, this would appear to be a delicate and a difficult subject; delicate because of diversity of sentiment, and difficult because of diversity of judgment, amongst those best qualified to speak, as to what academic ideals are, or as to what they should be. Hence it may seem fitting at the outset to suggest application to the views here set forth of the Socratic caution that they can hardly be exactly as represented, if not the more sweeping caution of Marcus Aurelius—'Remember that all is opinion.' But the delicacy and the difficulty of the subject

* Address read on the occasion of the opening exercises of Columbia University, September 28, 1904.

are probably more apparent than real to us; for this is a university assembly, and it is one of the highest functions of a university to examine the various aspects of debatable questions without suppression of candor and without loss of humor.

The typical American university of our time is a complex organization which has grown up rapidly from the typical American college of a half century ago. It has its undergraduate, its professional and its post-graduate schools, as we see them in Columbia University to-day. It has a heterogeneous aggregate of students animated by a great variety of aims and purposes. Its curricula embrace courses of study and research quite unknown to the educated public of thirty or forty years ago; and its degrees recognize professions quite unheard of before the middle of the nineteenth century. Moreover, the modern American university has broken to a large extent with custom and tradition. It is an institution characterized by intellectual agitation, by adjustment and readjustment, by construction and reconstruction, the end of which is not yet in sight. This complex organization is the resultant of the more or less conflicting educational activities of our times. It is a resultant due in part to world-wide influences; it expresses a generalized academic ideal.

Whatever may be our inherited prejudices or our calmer judgments, the attainment of this ideal must be regarded as a remarkable achievement. Here, for example, in this institution, we find all kinds of subjects of study, from the most ancient to the most modern, from the most practical to the most theoretical, from the most empirical to the most scientific, from the most materialistic to the most spiritualistic, all on a plane of intellectual equality and all equally available to those fitted to pursue them. Little surprise is manifested at the close juxtaposition of a professor of metallurgy and a professor of metaphysics, and it has actually been demonstrated that professors of poetry and professors of physics can dwell in peaceful activity under the same roof. Here too the ten or a dozen faculties and the various student bodies mingle and intermingle in a spirit of cooperation and mutual regard almost unknown outside, and hitherto little known within, the academic world.

The mere atmosphere, then, of a modern university must energize and elevate all those who come within its influence. But the domain of this atmosphere is not bounded by academic walls. It is not a limited medium within, but is actually a part of, the unlimited medium of the intellectual world; for the modern university has broken also with custom and tradition in allying itself closely with the external world of thought. Through interaction of the intramural and the extramural spheres of thought the instructor and the student are kept face to face with the vantage ground of contemporary life, whence they may look forward as well as backward.

The modern university is an institution of learning in the full sense of the word; an institution wherein instructors teach students, and wherein, reciprocally, to a very important degree, students teach instructors; for that instructor is fossilized who does not learn more per year from his students, if they are worthy of the name, than they learn from him. Together they work diligently not only to become acquainted with the known, but still more diligently to penetrate the secrets of the unknown. Among them there is a sentiment that condemns alike the instructor who would impart knowledge by the method of the rotary calabash, and the student who, with saturnine stolidity, would absorb only the information poured into his ears. Dwelling thus at a university, not apart from, but actually in, the world of contemporary thought, students may best fit themselves for the world of contemporary life; and while they may justly esteem it a great privilege to graduate from an historic college, or from a professional school of international reputation, they should esteem it a far higher privilege to graduate from a great university.

It should be observed also that the resultant ideal which has been attained in our best universities is not fixed but progressive, not inflexible but subject to improvement. It is a development whose sources are seen in the earliest civilizations, whose growth was dimly perceived during the middle ages, and whose conscious appreciation is a realization of the century just past. The method which characterizes this development is the method of science. It dates essentially from the epoch of Galileo and Huygens. It rose to a maximum of brilliancy in its interpretation of material phenomena during the epoch of Newton and Leibnitz, and during the epoch of Laplace and Lavoisier; and it has recently illuminated a new domain through the labors of Darwin and Spencer. Galileo, Newton and Laplace gave us a system of the inorganic world; Darwin and Spencer have given us a system which includes the organic world as well.

The method of science has permeated all regions of thought and animated all of the commercial, industrial, political, social and religious activities of men. Whether we welcome it, deplore it, or indifferently acquiesce in it, the fact seems undeniable that the method of science and the doctrine of evolution are the most effective sources of the intellectual enterprise of our day. Through anthropology this method and this doctrine have given a transcendent interest to the study of man; for they show that man may not only investigate the rest of the universe, but that he may, by the same means, investigate himself. Consciously or unconsciously, the terminology, the figures of speech and the modes of thought of science are being applied to all subjects and objects of human concern. They have penetrated the depths and the darkness even of the polite literature of our times.

But while the ideal thus outlined appears to be the effective, or working, ideal at which we have arrived, it goes without saying that it is not the only ideal entertained by those whose opinions on academic questions are worthy of regard. On the contrary, many eminent minds deplore present tendencies and write and speak regretfully of the vanishing ideals of the past. Grave publicists, accomplished men of letters and subtle philosophers see little but danger in the educational readjustments of recent times. They deplore especially the decline in popularity of those ancient studies long called the humanities and the contemporary rise and increasing recognition of the newer studies. Culture, they seem to claim, comes inevitably through the pursuit of the former, never through pursuit of the latter. They go so far in some cases as to decide at what point the study of a subject ceases to be liberal and begins to be illiberal, or professional. Give a student by the ancient formula, their facile editors say, that modicum of learning which would otherwise be dangerous, stamp him with the degree of A.B., and he becomes an aristocrat. They take a gloomy view of the restless present and they are little hopeful of the future; for they hint darkly of 'the bankruptcy of science' and of disasters impending if we do not return to ancient ideals.

Argument concerning these matters is fruitless. Logic avails as little in an educational campaign as political economy avails in a presidential campaign. Appeal must be had to our sense of humor and to the arbitrament of time. It may be observed, however, that these apostles of doubt and prophets of evil are slowly disappearing. They are more numerous outside than inside academic walls, they are less strenuous in large than in small colleges, and they are no longer dominant in the best universities. From a philosophic point of view they illustrate the action of a most interesting and usually beneficial sociological principle. When consciously applied this principle may be called the law of rational conservatism. When unconsciously applied it may be called, in analogy with a great physical principle, the law of conservation of ignorance. It is so much more important for society to protect itself against the follies of the unwise than it is to profit by the improvements of the wise, that progress comes, generally, only painfully slowly. May we not entertain the hypothesis that the contemporary opponents of educational reforms have been animated towards them rather unconsciously than consciously? Having drunk deeply at certain fountains of learning, they appear to be sure that there are no others. They seem to have been, and to be, always receding. For more than a thousand years, in fact, the gaze of most scholars has been fixed so steadfastly on the glories of the past that it has been possible to advance only by marching backwards.

Through the unconscious action of the law of the conservation of ignorance we are always in danger of disproportionate estimates of educational values and of erroneous judgments in the larger affairs of life. We involuntarily revert to precedent, commending what is old, condemning what is new. Thus, to give a concrete illustration, fear and panic would be visible in our faces if we did not understand the mythical significance of the names Phobos and Deimos lately applied to the moons of the planet Mars; but very few of us would betray the slightest mental disquietude at our profound lack of knowledge of the properties of the atmosphere which is the medium of communication between you and me in this room. Thus, also, in spite of the obvious aphorism that all men are human, they have been divided into humanists and non-humanists, Matthew Arnold, for example, being one of the former, and the founder of our John Tyndall Fellowship being one of the latter. And stranger still, one might infer from the slowness of legal and constitutional reforms, and from many current arguments opposed thereto, that laws and constitutions are not made by men for men, but that, in some mysterious way, men are merely experimental material for the training of crafty lawyers and sagacious politicians.

But we have broken irrevocably with the past; not in the sense of disregarding the rich heritage of experience from our distinguished predecessors, but in the sense that their customs and traditions no longer dominate us. We have corrected their observations for geocentric parallax; and we must now correct their observations for anthropocentric parallax, just as our successors, if they prove progressive, will surely correct our blunders and avoid our errors. The need of corrections for anthropocentric parallax in educational affairs is now widely recognized. It leads to the investigations of Mosely Commissions, to the conferences of the Association of American Universities, and to the broader conferences of world's fair congresses. It is the chief source of the educational activities of our day. In these activities are to be seen the most hopeful signs of the times; for while agitation does not necessarily mean progress, serene contentment is pretty certain to mean stagnation, if not regress.

And the readjustment now going on in the academic world must continue. It is a part, simply, of the readjustment going on in the intellectual world at large. We are, so to speak, in a state of unstable equilibrium, wherein mental repose can be purchased only at the price of mental somnolence. Great as have been the enlargement and the appreciation of educational and professional opportunities during the past three or four decades, we may confidently anticipate still wider enlargement and appreciation in the future. New divisions of knowledge may be expected to arise, and old divisions may be expected to undergo marked expansion, redistribution or emendation. The so-called humanities, especially, must be broadened, purified and elevated if possible to the intellectual level of the more highly developed sciences. It is clear, indeed, that in any revision of the humanities some matters may be redistributed, if not discarded, with advantage. The reckless amours and the clandestine peccadilloes of ancient and modern royalty, for example, should be transferred from the historian and the novelist to the anthropologist, the alienist and the pathologist. Such humanities, and many others of like kind, can hardly stand in comparison with the constancy of the stars and the beauties of harmonic analysis.

All these matters of controversy, however, belong rather to the lower than to the higher life of a university. How a student acquires elementary training is an academic question in the narrower sense of the word. The world cares little for educational ways and means unless they can commend themselves by results. Attainments must be tested by achievements and proficiency must be proved by progress. To rise to this standard of excellence is the ideal of the higher life of a university. It is only by the pursuit of, and in the realization of, this ideal, that instructors and students may keep pace with and contribute adequately to the advancement of modern knowledge. Those who would separate theory from practice, those who would draw lines of invidious distinction between pure and applied science, along with those who would mistake a part of archeology for the whole of education, are all alike inimical to the trend of current progress.

It is the highest function of a university to cherish this ideal and to promote especially the arduous labors essential to fruitful original research. Those who can add somewhat to the sum and substance of permanent knowledge by the establishment of a physical, a social, an esthetic or an ethical principle, are the greatest benefactors of our race. Of the many who feel drawn to this high calling, however, few are destined for fame. Only those who prefer the turmoil of conflicting thoughts to the tranquility of inherited opinions, who can bear alike the remorseless discipline of repeated failure and the prosperity of partial success, may hope to attain renown. But, as those serve also who stand resolutely and toil patiently at their allotted tasks, so is there room in the grand aggregate of human achievement for the humblest as well as for the noblest of investigators.

The ideals, then, of a modern university, like the ideals of the intellectual world at large, contemplate achievement and progress in all grades of work from the lowest to the highest. They demand endless patience and unflagging industry from all who seek to rise above the dead level of mediocrity. The opportunities now afforded for the pursuit of, for the acquirement of, and for the advancement of, learning are greater than ever before. We are the heirs of the ages. But along with an increasing heritage there come increasing duties and increasing responsibilities. It rests with us to show that we are worthy of this heritage and able to meet these duties and responsibilities. This is the line of endeavor we resume to-day, and the spirit of the hour bids us look forward with cheerful optimism.

R. S. Woodward.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*THE PRESENT STATE OF GEODESY.**

The problems of geodesy, like those of most sciences, enter upon new phases with the accumulation of facts bearing upon them. The problem of determining the amount of the earth's compression was added to that of determining the size of the supposed sphere as soon as Newton had demonstrated its oblateness. The controversy to which Newton's theory gave rise was settled by the famous geodetic operations of the eighteenth century which furnished the cardinal facts in regard to the earth's figure and size.

What may be regarded as the slow progress of a more precise knowledge of the earth's dimensions since that time must be attributed to the difficulties inherent in the problem.

In the first place the dimensional measurements must necessarily be confined to the continental areas which occupy but three elevenths of the earth's surface. The configuration and relationship of these areas make it impossible to girdle any section of the earth by direct measurement.

Secondly, the admeasurement of these areas is far beyond the reach of individual enterprise and can only take place when the practical needs of governments suggest the utility of great mensurational surveys which at the same time and without great additional expense will furnish the data required for a more perfect knowledge of the spheroid. In making this statement it is not forgotten that individuals and governments did undertake in all ages measurements for the purely scientific purpose of determining the size of the earth, for the desire for knowledge on this subject may be reckoned coeval with intellectual development of man.

Happily it may be said also that by their collective action the governments of the world have shown in recent times that it is considered a governmental function to support and promote researches in this branch of science. I allude, of course, to the existence of the International Geodetic Association. It will not be out of place to say in this connection that the association exists by virtue of a formal convention between the participating governments, which are, at the present time, the United States, Japan and Mexico and all the European nations save Portugal, Roumania and the group south of the Danube. No account of geodesy would be complete that failed to consider the aims and labors of this association. Its history is part of the history of geodesy since 1861. At that time it began its career as the Mittel Europäische Gradmesung. In a few years it expanded into an European association and in 1886 it became international.

It is not generally known that it was this association which instigated the French government to invite the world to establish an international bureau of weights and measures at Paris. Without detracting in any way from the labors of Bessel, Clarke and others in intercomparing geodetic standards, the successful labors of the bureau which in consequence was established in Paris removed at least some of the difficulties that were encountered by the investigators in this branch of science, and by those engaged in the practical work of the measurement of the earth.

The history of geodesy is full of instances of confusion and wasted energy due to the lack of a common standard, and the results of many arc measures which would

* Address of the vice-president and chairman of Section A—Mathematics and Astronomy, American Association, Philadelphia, December, 1904.

at least have great historic interest are utterly lost to us, because we can not make even a respectable guess at the units used. The adoption of an international unit of length and its necessary auxiliary, a common thermometric scale, and the provision which the various governments made for the reference of their measuring apparatus to a common unit was a step of fundamental importance.

The association as such has no control over the geodetic operations conducted by the different governments. Its function is to be the intermediary where cooperative action is needed, and to discover and point out along what lines the greatest need for information exists.

In pursuance of these duties it has helped to perfect the European systems of triangulation by showing where missing links should be supplied, not only by measurement of angles and bases but also by additional astronomical observations. It has made absolute gravity determinations with all the accuracy demanded by modern science and has caused suitable connection to be made by relative measures between widely scattered pendulum base stations, and it has instituted unique relative gravity measures, to which further reference will be made. It organized and maintains the stations for observing the variation of latitude in regard to which it should be remarked that it is the desire of the association to continue the observations beyond the year 1906, which marks the end of the ten-year period for which that service was tentatively organized. The association strongly desires not only to continue but to extend the service to the southern hemisphere and other latitudes than those now occupied by the permanent stations, and to obtain the cooperation of suitably situated observatories in their endeavor to discover the cause of the phenomena.

That the problem of determining the earth's dimensions could not be solved by simply measuring two arcs in suitable localities was brought home to geometers by the anomalous results obtained in the eighteenth century. For instance, according to Lindenau the combination of the two American arcs, Mason and Dixon's, measured in 1764, and that of Peru, measured a quarter of a century earlier, gave a value of one five-hundredths for the earth's compression. The value derived from those measured in Great Britain alone was about nine times as great, or one fifty-fifth, while those made in France, considered by themselves, gave one one-hundred-and-fiftieth. It is not now important to inquire whether these differences are not in part due to the crudities of the methods of measurement employed. They were sufficiently real to throw doubt on the belief that the earth could be represented by a regular mathematical figure. Finally, the existence of local deflections of the vertical as affecting the amplitude of arcs was recognized, but not taken into account save, perhaps, by arbitrary exclusion of stations showing exceptionally large deflections.

The method of finding an osculating spheroid from arc measures remained in its essence that of taking averages of measurements reduced to the geoidal surface. The differences between the observed directions of the vertical and those computed on an assumed spheroid of reference were treated as if they were accidental errors of observation. At the present time it is the aim of geodesists to assign to the deflections their proper place in the computations and to interpret them by discovering through them and through gravity measurements the manner of the distribution of masses in the interior of the earth. Thus geodesy is trenching on the domain of geophysics and geology.

In India, in Europe and in the United States the study of these deflections is receiving special attention. In the last-named countries the junction and correlation of the triangulation, which was formerly disjointed, makes it possible to take up the study. Similarly in this country the completion of the transcontinental arc and its connection with the lake survey triangulation furnished the opportunity and occasion for adopting a standard datum of geographical coordinates for the whole country. This in turn furnished the deflections of the vertical referred to a common origin of coordinates on the same spheroid and made it possible to begin the study of the form of the geoid in this country over a very extended area.

The investigation has so far been extended over the eastern part of the United States. Here as elsewhere it was found that the curves of elevation of the geoid above the spheroid reflect perceptibly the visible topographic features.

A preliminary statement of the scope of these investigations was recently given before the International Geographic Congress by Mr. Hayford, the chief of the computing division of the Coast and Geodetic Survey. From it I quote as follows:

> The conclusion that for the eastern half of the United States and the adjacent portion of the Atlantic the theory of isostasy is true to a considerable extent is reasonably safe. The conclusion that the depth within which the isostatic compensation takes place is 205 miles is one which may be modified considerably as the investigation proceeds.
>
> The investigation thus far leaves the signs of the corrections to the constants of the Clarke spheroid of 1866 uncertain.

Mr. Hayford will give before this meeting an account of the method devised by him of computing the topographic correction. The task of computing this correction to a distance of 4,000 kilometers for each of say 500 stations has been rendered possible by this method, which is, therefore, referred to by me as a distinct advance in geodesy.

It is hoped that the completion of the study of the data now available in regard to the deflections will serve as a guide to the most effective use in the future of the pendulum, and it is on this account largely that pendulum observations have been for the present deferred by the coast survey. They are, however, being actively made by other nations.

A new impetus was given to relative gravity observations by the adoption of short and light pendulums in place of the heavy seconds' pendulum. Aside from their portability, their lightness insures greater invariability for the knife edges, simplifies the task of securing uniformity of temperature and pressure in the metal cases in which they are swung, and the ease with which a low and constant pressure can be maintained in the case insures the continuance of the swing through so long a period that the errors of the chronometer or other timepiece are eliminated. Thanks to the efforts of the International Geodetic Association, the widely scattered base stations have been connected with the central station of the association at Potsdam, where a long series of absolute gravity determinations were brought to a successful conclusion two years ago. The association has available now the data from nearly 1,800 stations scattered over various parts of the globe. A most interesting and valuable extension of relative gravity measures to the surface of the ocean was made two years ago. The principle upon which the new method depends is that if the atmospheric pressure is determined at the same time and place by means of a mercurial barometer on the one hand and by the temperature of the boiling point of water on the other, the observed height of the barometer will be affected by gravity at the place, while the result by the hypsometer will be independent of it. According to Dr. Hecker, who carried out the laboratory experiments as well as the actual test at sea, the suggestion that the two instruments might be used for the determination of differences of gravity was first published in 1894 by Dr. Guillaume, of the International Bureau of Weights and Measures at Paris. Dr. Mohn, of Christiania, successfully applied the method by actual tests in various places in Norway for the purpose of determining the gravity reduction of the barometer for meteorological purposes. Doctor Hecker installed his apparatus on a steamship and sailed from Hamburg to Rio Janeiro via Lisbon, Portugal, and Bahia, Brazil, and returned on another steamer to Lisbon, making observations both ways. The results of his observations have been published and show:

1. That the intensity of gravity on the Atlantic Ocean between Lisbon and Bahia is nearly normal, and agrees with the theoretical values computed by means of the general formula published by Helmert in 1901.

2. That the difference of gravity at sea in shallow water and in deep water corresponds approximately to the difference of gravity between coast stations and inland stations.

These results were submitted to the Geodetic Association at the last meeting. Means were provided for another expedition and last March Dr. Hecker began his journey, crossing the Indian Ocean and the Pacific by way of Melbourne and Sydney to San Francisco. Thence he recrossed to Japan and China, and we may look forward to an early statement of the results, which are being awaited with deep interest.

As in the case of the pendulum already referred to, there has been in the last decade a decided improvement and simplification in instrumental means and methods of work. It is only necessary to cite the introduction of tapes and wires for primary base measurement, the introduction of the transit micrometer for the elimination of personal equation in time determinations, and of the leveling instrument, devised in the coast survey, which is making its way into more general use. With the use of the latter there has just been satisfactorily completed the first precise line connecting the Atlantic, Gulf and Pacific mean sea levels in the coasts of the United States.

In all countries the determination of the mean sea level and the establishment of so-called bench marks in the interior are being actively prosecuted as they furnish part of the required geodetic data.

In beginning I referred to the measurement of continental areas. Let us see what has been accomplished as to the extent of areal measurement since Snellius introduced triangulation into geodesy 289 years ago. In our own hemisphere, so far as I am able to learn, about the three-hundredth part of one per cent. of the area of South America has been covered; of Mexico about one per cent.; of the United States about five per cent. Geodetically the British possessions in the western hemisphere are barren. We may say that less than three per cent. of the western hemisphere has been triangulated.

In the eastern hemisphere we find that about forty per cent. of Europe has been covered, but if we leave out Russia the percentage rises to eighty per cent. for the rest of Europe.

The triangulation of Asia is furnished by India and Japan, Java and Sumatra and amounts to about four per cent.

Australia shows about two per cent., Africa about two and six tenths per cent., making a total for the eastern hemisphere of about seven per cent.

If we exclude the north and south polar regions a little over six per cent. of the available land area has been triangulated, or about one and one half per cent. of the total surface of the globe. These figures are accurate enough for the purpose for which they were compiled, that is, to show the relatively small area covered. There is, however, another side to the picture, the hopeful one. In South America the arc of Peru is being remeasured and extended by the French government. As the work is being carried out with the advice of the most distinguished mathematicians of France, the results will be, in their importance, out of all proportion to the extent and area involved.

Mexico has made a brave beginning and is working towards a connection with an extension of the ninety-eighth meridian measurement, of which the United States has completed about three quarters of the amplitude lying in her own domains. Work on the Pacific coast arc has been resumed and it has nearly been completed from San Diego to the Columbia River.

Two years ago the Russians and Swedes jointly completed an arc in Spitzbergen between latitudes 76° and 81°. The European arcs are being extended eastward by Russia, and one must look forward to the ultimate connection between the Russian triangulation at Astrakhan or Orsk and the Indian triangulation, however improbable it may seem if looked at from a political view point.

In Africa the work of extending the South African arcs northward from the Cape towards Alexandria is well under way, and no doubt need be entertained that the British and Germans will carry it through.

A general review of this part of the field of geodesy shows that while some great geodetic measurements have been completed or are approaching completion, new ones are being undertaken under the fostering care of different governments.

Reasoning from the experience of the past, we may conclude that the solution of one problem in geodesy will disclose the existence of another, and from the trend of the investigations of the present that other than purely mathematical and astronomical sciences will be advanced by the search for their solution.

That the progress of the branches of science to which this section of our association devotes itself was greatly affected by the problems of geodesy was pointed out by Humboldt in language which may fittingly conclude these remarks:

> Except the investigations concerning the parallax of the fixed stars, which led to the discovery of aberration and nutation, the history of science presents no problem in which the object obtained—the knowledge of the mean compression of the earth and the certainty that its figure is not a regular one—is so far surpassed in importance by the incidental gain which, in the course of long and arduous pursuit, has accrued in the general cultivation and advancement of mathematical and astronomical knowledge.

O. H. Tittmann.
U. S. Coast and Geodetic Survey.

*FUTURE DEVELOPMENTS IN PHYSICAL CHEMISTRY.**

It has been the custom of the retiring officers to discuss the development of some portion of that field of chemistry in which they were most interested. Since the president of the American Chemical Society will speak on physical chemistry tomorrow night, it has seemed to me that I might break with tradition and discuss the future of physical chemistry rather than its present or its past.

We have reached a critical stage in the development of the electrolytic dissociation theory. The work of Kahlenberg has shown that there are a number of facts which we did not anticipate and which we can not explain satisfactorily at the present time. The recent experiments of Noyes show that the dilution law does not hold for any strong electrolyte and that the

* Address of the vice-president and chairman of Section C—Chemistry, Philadelphia, 1904.

same empirical equation describes the behavior of binary and of ternary electrolytes. This last fact appears to be fatal to all explanations based on the assumption that electrostatic effects are the disturbing factors. While the mutual attraction or repulsion of two ions or of three ions may easily change the dissociation formula for a binary or a ternary electrolyte, it is very improbable that the changes will be such as to make two radically different formulas identical. Of course, the hypothesis of hydrated ions gives us some leeway but the outlook is not what it was five years ago. It is too soon yet to say whether we are merely to remodel the electrolytic dissociation theory or whether we are to replace it by something else. My own opinion is that reform is what is needed and not revolution. It is evident, however, that we have gone ahead too fast and that we must test more thoroughly the premises on which our conclusions are based. We know of one error. The proportionality between molecular weight and osmotic pressure holds only for the cases in which the heat of dilution is zero. This is stated clearly in van't Hoff's original deduction of the van't Hoff-Raoult formula $n/N = \log p/p_1$, but has been pretty generally overlooked. Since the heat of dilution is rarely zero in any actual case, our deductions as to the molecular weights of solutes are always somewhat in error. In the case of the metals of the alkalies and the alkaline earths dissolved in mercury, the lowering of the vapor-pressure due to the heat of dilution is practically equal to that due to the molecular weight, and we therefore have the surprising result that the apparent molecular weight is only about one half the atomic weight. One of the first things we have to do is to eliminate this source of error in all cases.

Another distressing feature in the quantitative physical chemistry of to-day is that the field which it covers is daily growing less. A tenth-normal solution is now considered a concentrated one, and some people are so extreme as to maintain that we can not expect agreement between theory and experiment for anything except infinitely dilute solutions. To my mind a theory which holds only for infinite dilution is necessarily wrong. Here again one probable source of error is easy to find. The van't Hoff-Raoult formula is deduced on the explicit assumption that there is no specific attraction between solvent and solute. If this assumption is wrong, it is reasonable to suppose that the error thus introduced would become less as the concentration approaches zero. Under these circumstances the van't Hoff-Raoult formula might represent the facts at infinite dilution without being a true formulation. This is the case with another well-known and important formula. The Helmholtz and the Nernst equations for the electromotive force of concentration cells are identical for infinitely dilute solutions and for these only. The Nernst equation ignores the concentration of the undissociated salt, while the Helmholtz formulation does not. The two equations become identical at the moment when the concentration of the undissociated salt and the disturbing factor due to it become zero, that is, at infinite dilution. Since the Helmholtz formula applies to all concentrations, the Nernst formula is necessarily only approximately accurate. This has been recognized explicitly by Planck, though the point is often overlooked. It is quite conceivable that the shortcomings of the van't Hoff-Raoult formula may be due in part to theoretical inaccuracies and that we have laid too much stress on 'variations from the gas laws.'

If we introduce the conception of a specific affinity between solvent and solute in certain cases, notably those in which the heat of dilution is marked, we combine all of what has stood the test with what is good in Kahlenberg's conceptions and I believe that we are nearly ready to take a long step forward. One point must be kept in mind, however. Raoult's experiments preceded his formula. Before we can hope to work out a satisfactory theory of concentrated solutions, we must have accurate measurements on concentrated solutions and at present we have practically none. We need experiments at constant temperature on the compositions of coexistent liquid and vapor phases for binary systems with one volatile component and with two volatile components. These measurements are not easy to make and that is one reason why they have not been made. We have measured boiling-points and freezing-points because they are easy to measure; but for a theory of concentrated solutions the value of such measurements is very small. This is because we are then measuring the combined effect of the change of the pressure with concentration and with temperature, whereas we ought to study the two separately. Further, if we are to express our results in volume concentrations we must give the volume concentrations of both components. It would be absurd to pass from dilute to syrupy solutions of sugar, for instance, and to treat the concentration of the water as constant. Personally, I believe that the theory of concentrated solutions is relatively simple and that the difficulties have been chiefly of our own making. My own experience with ternary mixtures confirms me in this view. In developing a theory of concentrated solutions we must also keep in mind the actual properties of the components, a thing which we have not done in the past. Thus the dissociation equation for liquid chloral hydrate can not be the same as that for liquid chloral alcoholate because chloral is miscible in all proportions with alcohol and forms two liquid layers with water. This is a perfectly obvious fact, yet no reference to it is to be found in any text-book on physical chemistry.

In the last ten years the work of Roozeboom and others has brought the phase rule to the front as a basis of classification and as an instrument of research. The importance of the phase rule is going to increase very rapidly in the next decade. The study of alloys has really only just begun. Our knowledge of the carbon steels is still very incomplete and unsatisfactory. In fact, we know the constitution only of a very limited number of binary alloys. Nothing systematic is yet known about the chemical properties of alloys or about the conditions for electrolytic precipitation. The variation of the engineering properties, such as tensile strength, torsional resistance, ductility, etc., with varying concentration and varying heat treatment is a subject which can only be worked out satisfactorily with the phase rule as a guide. On the basis of what has been done it appears quite safe to predict that we do not yet know one half the possibilities of our structural metals.

Quite recently the constitution of Portland cement has been established and we owe this result to an application of the phase rule. It will not be long now before we get much clearer ideas on the causes of the strength of cements and of the plasticity of the clays. The time will soon come in our engineering schools when the subject known as 'Materials of Engineering' will have to be taught by the chemist rather than by the engineer.

The applications of the phase rule to petrography will be numerous and will come soon. It is evident that no rational classification of minerals can be possible until the constitution of the minerals has been determined. The situation in regard to petrography is much the same to-day as it was in regard to alloys a few years ago and we may reasonably expect as satisfactory results from rocks as from metals. More and more people are experimenting with fused salts and the new geophysical laboratory at Washington is planning to study igneous rocks in the same thorough way that van't Hoff studied the Stassfurt deposits. The problem is a difficult one experimentally, but it can and will be solved.

The classification of electrochemistry under the phase rule is a problem of the immediate future. Some work has been done already, but it is confined to the discussion of the electromotive forces of certain reversible cells. What I mean is something vastly wider than this, the application of the phase rule to all electrolytic and electrothermal processes. Since electrochemistry is essentially chemistry, a classification which is of fundamental importance in chemistry must be equally necessary in electrochemistry.

The extension of the phase rule to organic chemistry is an achievement about which we like to dream, but the realization of it seems far off. To treat a large portion of organic chemistry as a system made up of carbon, hydrogen and oxygen will some day be possible; but at present we are balked by so-called 'passive resistances to change.' Theoretically methyl ether, $(CH_3)_2O$, and ethyl alcohol, C_2H_5OH, are two modifications of the substance C_2H_6O and they should be mutually convertible. Practically they are not. Only one of the three dibrombenzenes can theoretically be the stable form. Actually, we can not convert any one of them directly into either of the other two.

In spite of all this there is really quite a mass of material waiting to be worked up. Reversible equilibrium between hydrogen and oxygen can be realized at all temperatures. Reversible equilibrium between carbon, carbon monoxide and carbon dioxide is possible above 200°, while reversible equilibrium between carbon, methane, acetylene, ethane and hydrogen can be observed above 1200° without catalytic agents. Carbon monoxide and water react at 430° in presence of copper. Methane can be made from carbon monoxide and hydrogen at 250° in presence of nickel, while methyl alcohol can be changed to carbon monoxide and hydrogen by zinc dust. The decomposition of alcohols into aldehydes, or ketones, and hydrogen is reversible. Aldehydes can be changed into carbon monoxide and paraffines, though the reverse reaction has not been accomplished satisfactorily. Methylal and acetal are formed by a reversible reaction, while the ester formation has been studied for years. Formic acid decomposes into carbon monoxide and water when heated by itself, and into carbon dioxide and hydrogen when heated in presence of rhodium. Starting from carbon monoxide and caustic soda we can make sodium formate, carbonate and oxalate.

As yet only a few of these reactions have been studied with care and we do not know how many of them are reversible or what are the temperature limits. We do not even know whether colloidal metals act more effectively than the pulverulent metals, although it is very probable that they do. While we can not yet tell how far we may be able to go, it is clear that the attempt to apply the phase rule to organic chemistry opens up a most interesting field of research both as regards organic chemistry and as regards the theory of catalytic agents.

The usefulness of the phase rule in studying basic and double salts is being realized more and more by our friends the inorganic chemists. The recent work on the changing solubility of the hydroxides of many of the metals calls attention to a possibility of error which must not be overlooked. In all cases of hydrolysis there is always a possibility that equilibrium may not be reached in weeks or months. The only safe way is to reach the equilibrium from both sides. In this way and only in this way do we get any clue to the magnitude of the error involved and it is only after we have done this that we are justified in assuming that a reaction is irreversible.

The application of the phase rule to the fractional crystallization of rare earths would certainly lead to marked improvements. There are few people who could separate potassium and sodium chlorides by fractional crystallization, getting out all of each salt entirely pure. Even fewer would be able to separate potassium sulphate and copper sulphate. In spite of this we start in cheerfully on the fractional crystallization of an unknown number of elements having unknown properties. The result of all this is that we reach a point where further separation is impossible and yet we do not know why. This state of things is really the fault of the physical chemist and not of the inorganic chemist. It is not to be expected that the inorganic chemist can start in off-hand and apply the phase rule to the study of basic and double salts or of rare earths. Before this can be done the physical chemist must work out the methods and must be prepared to give explicit working directions, possibly in the form of recipes.

It must also be clear to you that a study of the conditions of existence of compounds, atomic and molecular, is a prerequisite to any theory of valency,

In the past, reactions in organic chemistry have been studied by physical chemists chiefly as examples of reaction velocity. There are two other fields which will receive more attention in the near future, namely, yields and irreversible reactions. The question of yields is in a very bad way. In Lassar-Cohn's admirable book on laboratory methods in organic chemistry there is an enormous amount of valuable material; but there is really very little in the way of theory. Although we know that a reversible reaction will run to an end if the concentration of one of the reacting substances be kept practically zero, surprisingly little use has been made of this principle. We know that certain reactions take place better in dilute solutions or at low temperatures or in certain solvents, but in most cases we can not tell why. In the pyridine method for introducing acetyl or benzoyl groups the pyridine is said to be effective because it is a weak base; but it is much more probable that it acts as a catalytic agent. We do not know how far the dehydrating action of certain reagents is simply a question of vapor-pressure or how far there is a specific effect due to the particular reagent. The action of sulphuric acid in the formation of ether is something more than a dehydrating effect, and the same is true of the effect of zinc chloride in the synthesis of ethyl chloride.

A single instance will be sufficient to show the state of confusion that exists. Anschütz's method of preparing certain esters was to saturate the solution with hydrochloric acid gas and to allow the solution to stand overnight. Fischer improved on this by adding less acid and by raising the temperature. He boiled for two hours and found that the hydrochloric acid concentration could be reduced to three per cent. without affecting the yield. There the matter is left and we are led to look upon a three per cent. concentration as having special merits, whereas this is undoubtedly merely a result of boiling for the arbitrary period of two hours. If Fischer had boiled for one hour only he would have had to use a stronger acid to have reached equilibrium in the allotted time. If he had boiled three hours, the lowest permissible concentration of hydrochloric acid would undoubtedly have been less than three per cent. Anschütz, on the other hand, worked at ordinary temperature and his solutions consequently needed more acid and more time to approximate to equilibrium. All of this is really first principles and it is only one case out of many. If any one will try to classify and explain the results given in Lassar-Cohn's book, he will find himself provided with enough interesting research to last him the rest of his natural life.

The second field for research to which I have alluded is that of irreversible reactions. In inorganic chemistry there are as yet no well-authenticated cases where a reaction starts and then stops short of equilibrium. The results of Pélabon on hydrogen and selenium and of Hélier on hydrogen and oxygen have been disputed by Bodenstein and must for the present be considered as wrong. In organic chemistry we appear to have many such reactions, typical instances being the formation of nitro-benzene and the decomposition of aldehyde into methane and carbon monoxide. While it is possible that these and other reactions run to an end in infinite time, we have not infinite time at our disposal, and it may, therefore, prove profitable to find out whether and how the apparent end-point varies with varying initial conditions. This work is desirable now and will become necessary if we should ever revise our opinions as to the theoretical possibility of an irreversible equilibrium. By definition we can not determine the existence of an irreversible equilibrium by approaching the end-point from the two sides. It seems to me probable, however, that we can draw conclusions from the reaction velocity. If we are dealing with a case of a theoretically reversible reaction running practically to an end, I can see no reason why the concentration of the decomposition products should have any effect on the reaction velocity, so long as we confine ourselves to gaseous systems. If, however, we are dealing with a theoretically irreversible reaction which does not run to an end, the reaction velocity would vary with the concentration of the decomposition products.

It should be noticed that it will not do to reason from the behavior of a system in presence of a catalytic agent to that of a system without a catalytic agent, since the catalytic agent may displace the equilibrium. Thus ethyl alcohol is decomposed by heated copper into aldehyde and hydrogen, while heated alumina changes it chiefly into ethylene and water. It was the study of organic solutes in organic solvents which led Raoult to the formulation of his law. It seems probable that a study of organic reactions may lead to an entirely new class of equilibria. If this happens it will throw much light on the preceding problem because it is very difficult to explain some of the peculiarities in regard to yields in organic chemistry so long as we are obliged to postulate reversible reactions only.

The theorem of Le Chatelier has been applied chiefly to heat and work effects, but this is by no means the extent of its usefulness. Wherever we get a reversible displacement of equilibrium by light, it must be possible to make use of this theorem. The change of color of the silver photochlorides is in accordance with the theorem; but there seems to be no reverse change in the dark. The simplest case with which to begin would appear to be the formation of ozone. There seems to be a contradiction here. Ozone is known to absorb ultra-violet light and yet it is believed to be formed by the action of ultra-violet light. Whether we are dealing with the same sets of rays in the two cases is a point that has not been settled. In fact, we do not know definitely whether ozone is formed by the action of ultra-violet light in the absence of electrical waves, though this is a matter easily settled by experiment. We know that ozone gives out light on decomposing, but we do not know anything about the spectrum of this light. It is quite probable also that we must formulate the theorem of Le Chatelier more exactly than we have hitherto done before we can apply it successfully to the phenomena of light. An instance based on electrical phenomena will show what I mean. If a voltaic cell be short-circuited the chemical change will be such as to decrease the electromotive force of the cell. If we do not keep the cell at constant temperature the Joule heat will cause the temperature to rise and this may either raise or lower the electromotive force of the cell. We are then really considering two phenomena, the electrical and the heat effects. One may mask the other completely.

In one case, at any rate, we know that we can apply the theorem of Le Chatelier to light phenomena. Suppose we have a gas enclosed in a transparent adiabatic vessel and concentrate upon it light of a wave-length that is absorbed by the gas. The temperature of the gas will rise and equilibrium will be reached when the gas has changed so that it no longer absorbs light of that particular wave-length or when the gas emits light of the same wave-length and intensity as that which is acting upon it. This emission by a gas at some temperature of the light which it absorbs at the same temperature is Kirchhoff's law, which thus appears as a special case of what the chemists call the theorem of Le Chatelier. To be frank, I do not now see how we are to apply this theorem to the phenomenon of phosphorescence, and yet we are dealing with an absorption and an emission of light. I venture to suggest that it is to the application of the theorem of Le Chatelier that we must look for a rational treatment of phosphorescence, fluorescence, chemiluminescence, etc., rather than to a theory of vibrating molecules. It will be time enough to discuss the application to radiations when we have solved the simpler problem of the theory of cold light.

A discussion of equilibrium relations would not be complete without some reference to the future of thermodynamics in chemistry. There are two radically distinct ways of considering the relation of thermodynamics to chemistry. One is to look upon thermodynamics as a mathematical shorthand. The aim of thermodynamics is then to present a consistent and formal treatment of the known energy relations. In this case thermodynamics deals with the past and not with the future; with the classification of knowledge and not with the discovery of new laws. This is the point of view of most mathematical chemists and it is because of this that we do not turn to the mathematical chemist for new ideas. There is another way of considering thermodynamics, namely, as an instrument of research. It is not too much to say that the mathematical chemist can work out in a few hours or days results which would take his less fortunate colleague months or even years to obtain. At present the race is to the tortoise and not to the hare; but I can not believe that this will always be so. Other things being equal, the man who can handle his thermodynamics will beat the man who can not; but in order to have that take place thermodynamics must be considered as an instrument of research and not as a branch of metaphysics. We must confess that the mathematical chemistry of the past decade has not done what it should have done and that there is no immediate prospect of any improvement. In the meantime we do not despair. There are great possibilities in the application of mathematics to chemistry and some day they will be developed.

So far we have considered problems involving equilibrium only. When we begin to study the conditions which make a reaction possible and which govern its rate, we are brought face to face with our need for a satisfactory theory of catalytic agents. We know experimentally the catalytic action of many substances on many reactions, but we have not even the first suggestion of an adequate theory. This is a subject of more vital importance than may appear at first sight. I wish to call your attention to two very important matters which depend directly upon catalytic agents. The first is the chemistry of plants. We can make in the laboratory many of the substances which the plant makes. Some of them, such as alizarine and indigo, we can make more cheaply than the plant can, and of a higher degree of purity. As yet we can not make any of them in the way the plant does, and this gap in our knowledge will have to be filled by the physical chemist, as the problem apparently does not appeal to the organic chemist. The plant does not use reverse coolers or sealed tubes; it does not boil with sulphuric acid or fuse with caustic potash; it has not metallic sodium and chlorine gas as reagents. The reagents on which the plant can draw are air, water and a few mineral salts. As catalytic agents it has heat, light, difference of electrical potential, enzymes—and itself, namely, living protoplasm. From the work of Bredig and others we know that colloidal metals, the so-called inorganic ferments, can be substituted for enzymes in some cases. As we do not yet know our limitations, it is quite possible that we can substitute inorganic catalytic agents for the enzymes in all cases. If that proves to be true we can then duplicate everything except the plant itself, and we shall be ready to determine how closely we can duplicate the reactions of the plant. The experiments of Sabatier and Senderens in France are distinctly encouraging, even though they do not carry us very far. By means of nickel powder it is possible to reduce acetaldehyde to alcohol with hydrogen at 30°. This is the best result that has been obtained and it indicates the possibilities. When we get a satisfactory theory of catalytic agents we shall undoubtedly be able to duplicate many of the plant syntheses and our failures will be interesting as bringing us nearer to the most difficult problem of all—that of life. Pending the development of a satisfactory theory of catalytic agents, there is much to be done in the way of experimenting. In view of the fact that mixtures of two catalytic agents often act more intensely than would be expected from the behavior of each taken singly, it would appear advisable to determine the combined effects of inorganic ferments and ultra-violet light.

The second problem, which would be easier of attack if we had a satisfactory theory of catalytic agents, is that of the transmutation of the elements. This is now admitted to be distinctly a scientific problem, though not one in which we have made much progress. It is usually assumed that it is a very difficult problem. While this may be true, we have not yet reached the point where we are justified in being certain of it. No one has ever attacked the problem systematically and all we can say is that the rate of change has been small under any conditions that we have yet realized. That is not surprising. We should naturally expect a low reaction velocity. The rate of change of radium is so slight that it could not be detected by any ordinary methods. The fact that we have never observed any transmutation of the elements does not prove that none has taken place. We had been making diamonds artificially for years, even for centuries, but nobody thought of looking for them in cast iron until after Moissan made his experiments a few years ago.

If we accept Lockyer's conclusions as to the state of things in the sun, we could undoubtedly break up many of the elements if we could hold them long enough at 6000° C. One difficulty is to get the temperature, and of course we must be cautious about conclusions based on simplified spectra. Many people have thought that radium was to be the catalytic agent which was to change all the elements; but the recent work of Rutherford seems to put an end to this idea. If radio-active lead, tellurium and bismuth are merely these elements plus the radium emanation or one of its decomposition products, there is very little evidence to show that any of our well-established elements are undergoing any change from contact with radioactive substances.

Another possibility which has been suggested is that we could change our elements if we could pump energy into them and change their energy content. This would have to be done electrically if at all. I have been told that Stas was busy during the last years of his life trying to change sodium into something else by an electrical process. The difficulty is to pump energy into the element. Passing a heavy current through a metal produces no effect that we know of other than to raise the temperature. Taking the element in the state of gas enables us to employ a higher potential difference, but here the effectiveness of the method is limited by the appearance of the arc. The first stage in the problem would, therefore, be the attainment of the highest possible potential difference without causing arcing. In view of the remarkable insulating action of gases under high pressure, it seems as though the silent discharge through compressed gases were the thing to try. The difficulties people had in proving the dissociation of water at high temperatures makes us realize the possibility that we might decompose our elements and never know it, owing to the recombination taking place at once. If we are to simplify our elements by pumping energy into them, it appears that we should work with gases under high pressure, with the highest potential difference compatible with the absence of sparking, and with some application of the principle of the hot-cold tube.

While the methods of extremely high temperature and of high electrical stress have much to commend them on paper, they are liable to fail owing to the difficulty of attaining the proper temperature or the proper electrical stress. The ideal method would be to find a catalytic agent which would accelerate the rate of change and which would eliminate what we should then call the instable elements. Since there is no immediate prospect of our being able to predict the suitable catalytic agent and the conditions under which it is to be used, we must ask ourselves what is the scientific method of attacking the problem of the transmutation of the elements.

The answer is a simple one. We must start with the simplest case, study that thoroughly, and work up gradually to the more difficult tasks. We should begin with the cases in which we know a change is possible and should study the allotropic forms of the elements. At present our knowledge of these is disgracefully incomplete. We know a little about sulphur, phosphorus, carbon, selenium and tin; but even for these few elements our knowledge is incomplete and it is especially unsatisfactory in matters bearing on the rate of change. In most cases the change from one allotropic form to the more stable one is fairly slow. It is not even easy to get large amounts of gray tin. On the other hand, Saunders discovered, quite by accident, that there were a number of substances, notably quinoline, which convert amorphous selenium into the more stable, black, metallic modification. It is probable that similar results could be obtained with other elements. Kastle has shown that the rate of change of yellow mercuric iodide into the red form varies enormously with the nature of the solvent. The first thing that we need is a systematic study of the allotropic forms of the elements, considering reaction velocity as well as equilibrium. We next take up cases where the change from one form to another can be made increasingly difficult. The three disubstituted benzene compounds, as I have already said, are to be considered as different modifications, only one of which can be stable as solid phase at any given temperature and under atmospheric pressure. According to the text-books *o*-phenol sulphonic acid changes readily into *p*-phenol sulphonic acid on heating. When bromine acts on phenol in the cold, *p*-bromphenol is formed, while *o*-bromphenol is formed when the reaction takes place at 180°. I have not been able to find any record of the *p*-brom compound changing into the *o*-brom compound on heating; but the experiment is worth trying. When we come to the three dibrombenzenes, we have a case where we know that the three forms are identical in composition and where there is certainly some sort of an equilibrium at the time of formation because the relative amounts of the modifications can be changed by varying the conditions of preparation. In spite of all this we know no way of converting two of these compounds directly into the third. We could undoubtedly do it if we could raise the temperature high enough, just as we could also convert the elements. It is as yet impossible to attain the temperature at which the elements change rapidly, while secondary reactions interfere in the case of the organic compounds. So long as we can not change the two less stable forms of any disubstituted benzene compound into the most stable form, there is no reason why we should expect to succeed in what may, perhaps, be the impossible task of simplifying the elements.

Summing up, the future developments in physical chemistry will comprise a theory of concentrated solutions, further applications of the phase rule and of the theorem of Le Chatelier, a systematic study of organic chemistry, and a theory of catalysis. Wilder D. Bancroft.

REPORTS OF COMMITTEES.

The following reports of committees were presented to the council. They were accepted and ordered printed:

On the International Congress of Americanists.

The International Congress of Americanists held its fourteenth biennial meeting in Stuttgart, Germany, August 18–23, 1904. On June 1, 1904, I received a communication from you announcing my appointment as the representative of the American Association for the Advancement of Science at this meeting. The designation was gladly accepted, as it had already been arranged that I should attend the congress on behalf of the Smithsonian Institution.

I now have the honor to report that the meeting was in every way a most gratifying success and that the representation of the American Association was duly recognized and published in the official bulletins of the congress. The attendance was largely German, but representatives from a dozen other countries were present and took an active part in the proceedings. The papers presented related almost exclusively to American history and anthropology and especially to South American subjects. The Germans as well as the French have given very great attention to investigations on that continent.

The next meeting of the congress is to be held at Quebec in August, 1906.

Very respectfully,

W. H. Holmes.

On Anthropometry.

The committee beg to report that individually and as a committee they have been carrying on anthropometric work during the past year. It was not feasible to arrange an anthropometric laboratory last year at St. Louis, but this year excellent arrangements have been made in connection with the psychological laboratory of the University of Pennsylvania. Measurements of the members of the association are being made by Messrs. V. A. C. Henmon, F. Bruner and G. C. Fracker, with the cooperation of Professor Thorndike, Dr. Woodworth and members of the committee. The chairman of the committee is making an extended study of American men of science; two papers have been published on the subject and there is now in press a 'Biographical Directory of American Men of Science,' containing much material that can be used. We may call special attention to the Anthropometric and Psychometric Laboratory of the Louisiana Purchase Exposition, arranged by Dr. McGee, head of the Department of Anthropology. The laboratory, under the direction of Dr. Woodworth, assisted by Mr. Bruner, made measurements of about 1,000 representatives of different races, especial attention being paid to the native races of the Philippine Islands.

We ask that the committee be continued and that an appropriation of fifty dollars be made for the expenses of an anthropometric laboratory at the next meeting of the association.

J. McKeen Cattell,
Chairman.

On the Atomic Weight of Thorium.

The work on the 'Complexity of Thorium' by Chas. Baskerville and R. O. E. Davis, referred to in our last report, has been repeated, verified and extended by Fritz Zerban. The investigation was prosecuted partly in the laboratory of the University of North Carolina and is continuing in the College of the City of New York. Larger amounts of the pure thorium compounds have been fractioned. Baskerville and Zerban are at present busied with removing entirely from the new thorium the contaminating constituents preliminary to a determination of its physical constants. Coincident with this work they are studying the properties of the novel impurities, which have been designated 'carolinium' and 'berzelium.' The research is being aided by the Carnegie Institution.

Concerning the second problem assigned your committee for supervision, namely, the work of præseodymium, it would make the following report: Baskerville and G. MacNider did not succeed in proving the complexity of that constituent of the old didymium. The methods of attack were: (1) Production of higher oxides by fusion with sodium dioxide; (2) fractional solution of the well known black oxide in hydrochloric acid at variable temperatures; and (3) fractional precipitation of the oxalate at different temperatures —zero, 20°, and 100° C. A Zeiss comparison spectrometer, purchased by a grant from the council, was used for controlling the progress of the work, which will be continued.

We, therefore, beg leave to report progress.

Respectfully submitted,
Chas. Baskerville,
Capt. Sixs Honz,
F. P. Venable.

On Cave Fauna.

Owing to the absence of the secretary of your committee in the caves of Cuba during the last meeting of the association, a report on progress was omitted at the St. Louis meeting.

Since the last report the following papers based in part at least on material collected with the grant of three years ago have been published:

1. 'Report on the Fresh-water Fishes at Western Cuba.' *Bull. U. S. Fish Comm.* for 1902, 211–136.

2. 'The Water Supply of Havana, Cuba,' Science, N. S., XVII., 281–282.

3. 'The Eyes of *Typhlops lumbricalis*, a Blind Snake from Cuba.' *Biol. Bull.*, V., 261–270, by Mrs. E. F. Muhse.

4. 'The Ovarian Structures of the Viviparous Blind Fishes *Lucifuga* and *Stygicola*.' *Biol. Bull.*, VI., 31–54, by H. H. Lane.

5. 'The History of the Eye of *Amblyopsis* from the Beginning of its Development to its Integration in Old Age.' Mark Anniversary Volume, 167–204.

6. 'Divergence and Convergence in Fishes.' In the press of the *Biol. Bull.*

Number five is the most important of these and gives a complete account of the eyes of the largest of our blind fishes. Further work on this form should consist in noting the changes of the eyes in individuals reared in the light.

Several papers are in preparation.

Several years ago a Mr. Donaldson died in Scotland, owner of a farm of somewhat over 182 acres of land near Mitchell, Ind. He was apparently without legal heirs. Suit was brought by the state of Indiana to have this farm escheat to the state. The suit was contested by Scottish heirs of Mr. Donaldson, but was won by the state. This farm is in the midst of the cave region of the

Ohio Valley, to which belong Wyandotte and Mammoth caves, and is much more ideally adapted for experimental work with cave animals than either of the larger caves. On it are easily accessible some very large rooms provided with water. On it are the only entrances to an underground stream which I have followed over a mile by actual measurement and from which all of my material of *Amblyopsis* was obtained. Finally on it the stream comes to the surface under conditions that make the farm admirably adapted for surface ponds and pools to rear cave animals in the light.

The American Association at its Washington meeting passed resolutions asking the state of Indiana to set this aside for a state reservation, and part of it for an experimental farm for the investigation of cave animals, etc. In the winter of 1902 the state legislature passed a bill in part as follows:

"The title of all such lands shall be and remain in the state of Indiana, and such lands shall be devoted to educational purposes.

"The control and management of all such lands shall be vested in the trustees of Indiana University and such lands may be used by said trustees for any proper educational purposes.

"Said board of trustees may in its discretion set off any portion of such grounds to the use of the state board of forestry or to that of Purdue University, or any other educational or scientific institution of the state."

In the meanwhile the heirs appealed the suit to the supreme court of Indiana which also ruled in favor of the state in August of 1903. The heirs thereupon asked the same supreme court to grant them a new hearing before itself and there the matter has been suspended for over a year. It seems very probable that this farm will ultimately pass into the possession of the Indiana University and can then be used for experimental work with cave animals.

I have personally received a grant from the Carnegie Institution which enabled me to make further attempts to secure the embryological material of the Cuban blind fishes, without, however, being entirely successful in securing this much-desired series of embryos.

The most notable and systematic piece of cave work so far undertaken is in preparation by my assistant, Mr. A. M. Banta. He is making a physical and biological survey of Mayfield's cave, situated but five miles from my laboratory. He has determined the distribution of animals in the cave, the per cents. of the total cave fauna that is accidental, occasional or permanent. He is working in the interrelation of these forms and determining the modifications of the permanent members of the fauna to adapt them to cave life. This piece of work will form a base line for future work with the fauna of caves, and it is very desirable that Mr. Banta be enabled to make similar studies of a few selected caves in the various cave regions of America.

It is recommended that the committee be continued and that an appropriation of $100 be made to continue the work of the committee.

Respectfully submitted for the committee.

C. H. EIGENMANN, *Secretary*,
THEO. GILL,
S. H. GAGE.

On Indexing Chemical Literature.

The committee on indexing chemical literature, appointed by your body at the Montreal meeting in 1882, respectfully presents to the Chemical Section its twenty-second annual report, covering the eighteen months ending December 1, 1904.

Works Published:

'A Select Bibliography of Chemistry, 1492–1902,' by Henry Carrington Bolton, Second Supplement. Smithsonian Miscellaneous Collections, No. 1440, City of Washington, 1904.

This supplement brings down the literature of chemistry from the close of the year 1897 to the close of the year 1902. The author died while the publication was in press and most of the proof-reading, as well as the preparation of the index, was done by Mr. Axel Moth, of the New York Public Library.

In the *Arbeiten aus dem Kaiserlichen Gesundheitsamt*, volume 21, pages 141 to 155, appears a critical bibliography of sulfur dioxid in wine, by W. Kerp.

Indexes on the literature of gallium and of germanium, by Dr. Philip E. Browning, of New Haven, Conn., have been completed and accepted by the Smithsonian Institution for publication.

An index to the literature of radium and radioactivity has been completed by Dr. Chas. Baskerville and Mr. Geo. F. Kunz, and is expected to appear in a bulletin of the United States Geological Survey, as an appendix to a paper by Mr. Kunz on radium.

An index to the literature of solubilities, 1875–1903, by Mr. Atherton Seidell, of the Bureau of Soils, is now in the hands of the committee.

The index to the literature of glucinum by Professor Chas. E. Parsons, of New Hampshire College, Durham, N. H., has been completed.

As is well known for a number of years such bibliographies as have been recommended by their committee have been accepted by the Smithsonian Institution for publication in its 'Miscellaneous Collections.' It has thus been possible to put into the hands of specialists and others valuable indexes which could not otherwise be rendered accessible.

That it is not deemed possible for the Smithsonian Institution to continue this work appears from the following extracts from correspondence with Mr. S. P. Langley, Secretary of the Institution:

"The institution has found it necessary to discontinue for the present the publication of separate indices to the literature of the various chemical elements.

"The resources of the Smithsonian Institution, as is well known, are limited, and must be distributed over a very considerable variety of interests. When, failing congressional aid, it seemed that the project of the International Catalogue of Scientific Literature could not proceed without the establishment of an American regional bureau, I decided to assume this on the part of the Smithsonian Institution, and the allotment made for this purpose is practically all that can be spared for any current indexing work.

"The various bibliographies to chemical elements and other chemical indexes could not, apparently, have been projected upon a plan that would fall in with this catalogue, since at the time they were begun no one had the catalogue in mind. Accordingly, I find that the earlier ones come down to 1887, 1893, 1896 and 1900, and a more recent one, thorium, down to 1902. This brings up the entire question of retrospective indexing and bibliography previous to the date 1901, designed to cover the period prior to the beginning of the international catalogue. Such a project for all science should, of course, only be taken up after mature deliberation, and could only be carried through by international cooperation. Meanwhile it seems prudent for the institution to await a careful consideration on the part of all interested in the whole subject, chemistry, being of course, but one of the large group of sciences whose workers must be considered. In view of these considerations, the importance of which you will, I am sure, recognize, I am constrained to leave the entire matter in abeyance for the present."

In view of the above it may be questionable whether the work of this committee has not been completed as far as it is possible to carry out the offices for which it was originally constituted. It may, however, be wise to continue it for another year, to await developments.

In conclusion, references should be made to the great loss sustained by the committee, the section and the association, in the death on November 19, 1903, of Dr. Henry Carrington Bolton, who from the first appointment of this committee has been its chairman. The work of Dr. Bolton in the field of chemical and alchemical bibliography needs no encomium; it is invaluable to all workers in these fields.

Jas. Lewis Howe, *Chairman*,
F. W. Clarke,
H. W. Wiley.

On Electrochemistry.

A pure iridium electrode was purchased, and some rhodium powder. It was deemed advisable to precede the electrochemical portion of the investigation by a study of the chemical phenomena caused by these metals when no current passed. With this in view experiments have been made on the action of these metals on formic acid. These have confirmed the qualitative results of Deville and Debray, that the decomposition products are essentially carbon dioxid and hydrogen under these circumstances and not carbon monoxide and water. The reaction starts at a higher temperature than one would have supposed from the statement of Deville and Debray as to 'gentle heating.' The rate of decomposition of liquid formic acid is constant when the decomposition products are allowed to pass off, but there is need of the further study of the behavior of the acid in a closed space. This will be taken up next, and after that the electrolysis. The effect of the iridium on the chemical and electrochemical equilibrium between chlorine and water will also be studied. For this work your committee asks for a grant of an additional sixty dollars.

The committee begs leave to report progress.

Respectfully,
Wilder D. Bancroft,
Edgar F. Smith.

On Grants.

The committee on grants recommended that the following grants be made for the year 1905:

To the Committee on Anthropometry, $50.

To the Committee on Electrochemistry, $60.

To the Committee on Cave Fauna, $100.

To the Concilium Bibliographicum, $100.

To W. H. Dall, to assist in republishing a rare work on mollusks, the amount to be repaid in the printed volumes, $50.

L. O. Howard,
Chairman.

On the Walter Reed Memorial.

At a meeting of the association held in Washington, a committee was appointed, of which I was made chairman, to take such measure as might be found wise for securing a permanent memorial of Major Walter Reed, U. S. A., in recognition of his important services to humanity. Acting under this authority, it was at length found expedient, after several preliminary meetings, to form an incorporation in the city of Washington to hold such funds as might be contributed. This incorporation is now endeavoring to raise the sum of $25,000, of which the income may be paid to Mrs. Reed and the principal may be devoted to a permanent memorial of Dr. Reed. More than $13,000 has been subscribed already, a large part of this amount coming from the medical profession. This is all in addition to the action of Congress, which has given, on the representations of your committee, an unusual pension to Mrs. Reed.

The effort is now making to secure the additional sum of $12,000, and the cooperation of all members of the American Association for the Advancement of Science is urgently desired.

Yours respectfully,
DANIEL E. GILMAN,
Chairman.

On the Relations of the Association to the Journal 'Science.'

We beg to report that the arrangement by which SCIENCE publishes the official notices and proceedings of the association and is sent free of charge to the members in regular standing on payment of two dollars for each appears to give satisfaction. We recommend that the contract with The Macmillan Company be renewed for the year 1905.

SIMON NEWCOMB, *Chairman*,
CARROLL D. WRIGHT,
L. O. HOWARD,
R. S. WOODWARD,
J. McK. CATTELL,
G. K. GILBERT.

The following members of the association were elected fellows:

Section A:

Hayes, Ellen, Wellesley, Mass.
Milham, Willis I., Williamstown, Mass.
Quinn, John Jones, Warren, Pa.

Section B:

Davis, Bergen, New York City.
Lewis, E. Percival, University of California.
Pegram, George Braxton, Columbia Univ., New York City.

Section C:

Dorr, Allen Wade, Washington, D. C.
Martin, F. W., College Park, Lynchburg, Va.
Schober, Wm. B., Lehigh University, South Bethlehem, Pa.

Section D:

Bissell, Geo. W., Ames, Iowa.
Blanchard, A. H., Providence, R. I.
Greene, Arthur Maurice, Jr., Columbia, Mo.
Loewenstein, L. E., South Bethlehem, Pa.
McCaustland, E. J., Ithaca, N. Y.
Wood, Arthur J., State College, Pa.

Section E:

Aguilera, Jose G., Mexico, Mex.
Bawell, Joseph, 105 Bishop St., New Haven, Conn.
Bayley, W. S., Waterville, Me.
Berkey, C. P., New York City.
Bien, Julius, 140 Sixth Ave., New York.
Boutwell, John Mason, Washington, D. C.
Bownocker, J. A., Columbus, Ohio.
Brooks, Alfred Hulse, Washington, D. C.
Bryant, Henry G., 2013 Walnut St., Phila.
Buckley, Ernest R., Rolla, Mo.
Campbell, Henry Donald, Lexington, Va.
Campbell, Marius R., Washington, D. C.
Cobb, Collier, Chapel Hill, N. C.
Collier, Arthur James, Washington, D. C.
Cowles, Miss Louise F., South Hadley, Mass.
Curtis, Geo. C., Boston, Mass.
Douglas, James, 99 John St., New York City.
Fuller, Myron S., Washington, D. C.
Goode, John Paul, Chicago, Ill.
Gordon, Charles H., Seattle, Washington.
Graham, A. W., New York City.
Grimsley, Geo. Perry.
Hayes, C. Willard, Washington, D. C.
Heilprin, A., Academy Natural Sciences, Phila.
Lyman, Benj. S., Philadelphia.
Merriam, John C., Berkeley, Calif.
Penfield, S. L., Yale University, New Haven, Conn.
Tower, Ralph Winfred, American Museum of Natural History, New York City.

Section F:

Allis, E. P., Menton, France.
Bailey, Vernon, Washington, D. C.
Bawden, H. Heath, Vassar College, Poughkeepsie, N. Y.
Beebe, C. W., New York City.
Birge, E. A., Madison, Wis.
Blake, Joseph A., 601 Madison Ave., New York City.

Brown, Arthur Erwin, Phila.
Curtis, Winterton C., Columbia, Mo.
Dahlgren, Ulric, Princeton. N. J.
Davison, Alvin, Lafayette College, Easton, Pa.
Duerden, J. E., Chapel Hill, N. C.
Evermann, Barton W., Washington, D. C.
Glover, M. Allen, Cambridge, Mass.
Guyer, M. F., Cincinnati, O.
Hall, Robert William, South Bethlehem, Pa.
Herrick, Francis Hobart, Cleveland, O.
Hunter, Walter David, Cosmos Club, Washington, D. C.
Jenkins, O. P., Stanford University.
Jones, Lynds, Oberlin, O.
Knower, H. McE., Baltimore, Md.
Linton, Edwin, Washington, Pa.
McGregor, James Howard, New York City.
Mead, A. D., Providence, R. I.
Nachtrieb, H. F., Minneapolis, Minn.
Neal, H. V., Galesburg, Ill.
Osgood, W. H., Washington, D. C.
Rand, Herbert Wilbur, Cambridge, Mass.
Rankin, Walter M., Princeton University, Princeton, N. J.
Raymond, Pearl, Ann Arbor, Mich.
Rice, E. L., Delaware, O.
Torrey, Harry Beal, Berkeley, Calif.
Weysse, Arthur W., Boston, Mass.
Wilder, Harris Hawthorne, Northampton, Mass.
Zeleny, Charles, Chicago, Ill.

Section G:

Ames, Oakes, North Easton, Mass.
Banker, Howard J., Greencastle, Ind.
Berry, Edward W., Passaic, N. J.
Blodgett, Frederick H., College Park, Md.
Burrill, Thomas J., Urbana, Ill.
Cannon, W. A., Tucson, Ariz.
Coker, Wm. C., Chapel Hill, N. C.
Coulter, S. M., St. Louis, Mo.
Duval, Joseph W., Washington, D. C.
Ferguson, A. McG.
Fitzpatrick, Iowa City, Iowa.
Holferty, George M., St. Louis, Mo.
Jeffrey, E. C., Cambridge, Mass.
Kirkwood, Jos. E., Syracuse, N. Y.
Piper, C. V., Washington, D. C.
Pond, Raymond H., 87 Lake St., Chicago, Ill.
Rose, J. N., Washington, D. C.
Shull, G. H., Cold Spring Harbor.
Spillman, Wm. Jasper, Washington, D. C.
Thornber, J. J., Tucson, Ariz.
Wylie, R. B., Sioux City, Iowa.

Section H:

Bair, Joseph H., Boulder, Colo.
Baird, John Wallace, Baltimore, Md.
Churchill, William, New Haven, Conn.
Dellenbaugh, Century Club, New York City.
Fracker, George Cutler, New York City.
Haines, Thomas Harvey, Columbus, O.
Jones, Adam Leroy, New York City.
Kirkpatrick, E. A., Fitchburg, Mass.
Messenger, James Franklin, Winona, Minn.
Spaulding. Edward G., New York City.
Witmer, Lightner, Philadelphia.
Woodbridge, Frederick J. E., New York City.

Section I:

Burton, Theodore E., Cleveland, O.
Clark, Judson F., Montreal, Canada.
Du Bois, William E. B., Atlanta, Ga.
Edmonds, Richard H., Baltimore, Md.
Foote, Allen Ripley, Home Ins. Bldg., Chicago.
MacVannel, John Angus, New York City.
Stoke, Alfred Holt, Greenville, Miss.
Stokes, Anson Phelps, New York City.

Section K:

Abbott, Alexander C., University of Pennsylvania.
Burton-Opitz, Russell, New York City.
Dexter, E. G., Urbana, Ill.
Flexner, Simon, Rockefeller Institute, New York City.
Lindley, Ernest H., University of Indiana, Bloomington, Ind.
Loeb, Leo, University of Pennsylvania.
Meyer, Adolf, New York City.
Smith, Allen J., University of Pennsylvania.
Yerkes, Robert Mearns, Cambridge, Mass.

SCIENTIFIC BOOKS.

Elements of the Differential and Integral Calculus. By W. A. Granville. Boston, Ginn and Company. Pp. xiv + 463.

A characteristic feature of mathematics in the last half century is the increasing attention paid to the foundations and rigorous development of this science. In analysis this movement began with Gauss, Cauchy and Abel in the early years of the nineteenth century and found its greatest exponent in Weierstrass. The movement thus begun has been continued by such men as Riemann, Dedekind, Hankel, Cantor, Jordan, Dini, Stolz, Harnack, Peano and a host of younger men.

As a result of these investigations it was found that much of the reasoning hitherto employed and in current use among mathematicians was either worthless or required to be modified, restricted or completed. It thus became necessary to rewrite textbooks on analysis or to prepare new ones more in harmony with the new teachings. In this way arose the new edition of Jordan's 'Cours d'Analyse' and Harnack's edition of Serret's 'Calcul,' as well as the new works of Stolz, 'Allgemeine Arithmetik,' and 'Grundzüge'; Tannery, 'Théorie des fonctions d'une variable'; Dini, 'Fondamenti per la teorica delle funzioni di variabili reali.'

In England and America more progressive teachers have felt for some time the need of a modern text-book on the calculus, which is at once rigorous and elementary. The task of writing such a work is not easy. On the one hand, it is necessary to avoid the worthless and even vicious forms of reasoning which mar so many elementary treatises and which are simply intolerable to one educated according to modern standards of rigor. On the other hand, the author must not introduce subtilties of reasoning and logical refinements beyond the needs and comprehension of those who are to use the book.

The volume under review is an attempt to solve this difficult problem. To our mind the efforts of its author have been abundantly crowned with success. In perusing Dr. Granville's book one feels throughout that the author has in mind the requirements of modern rigor. The demonstrations, it is true, often rest on intuition; but this is necessary in a first course, as all will admit. They are, however, usually correct as far as they go, and free from the defects we have mentioned above. We believe the present volume is eminently a safe book to put in the hands of the beginner. He will get no false notions which afterwards will have to be eradicated, with much difficulty; he will, on the other hand, acquire a considerable acquaintance with the principles of the calculus and a good working knowledge of its methods.

We make now a number of criticisms and suggestions.

The definition of limit given in § 29 is not the one given by Cauchy and Weierstrass and now universally accepted. Looked at carefully, we see it supposes that all variables are functions of an auxiliary variable, the time. This leads to unnecessary complications in the definition of the limit of a function in § 32. We believe the strict Weierstrassian definition should be given and used. As an aid to comprehension, the author's notions in these articles might prove useful. In § 34 the notion of a graph is explained; but not with sufficient care, to our mind. How is the reader to know from their graphs that x and $\log x$ are continuous functions? The three properties of the exponential function given in this article result from their arithmetical properties and not from their graph, as the author seems to imply.

The definition of the derivative given in § 41 is not satisfactory; what the author really defines is the differential coefficient at a point. It is their aggregate that forms the derivative.

In § 55 the author has avoided an error which is very prevalent. His passage to the limit is, however, not completely justified. He has yet to show that

$$\lim_{\Delta x=0} \frac{\Delta y}{\Delta v} \cdot \frac{\Delta v}{\Delta x} = \lim_{\Delta v=0} \frac{\Delta y}{\Delta v} \cdot \lim_{\Delta x=0} \frac{\Delta v}{\Delta x}.$$

The demonstration in § 56 should, it seems to us, be replaced by a simpler one. The author obtains the equation

$$1 = \frac{dy}{dx} \cdot \frac{dx}{dy} \tag{1}$$

and then remarks: if $dx/dy \neq 0$, we have

$$\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$$

He should see that there can be no need of making the further assumption, $dx/dy \neq 0$: for if it were, the equation (1) could not exist.

In § 133 the author introduces a double limit without any explanation. As such limits are used in connection with double integrals, § 231, *seq.*, they should be explained with care. The footnote on page 194 is unintelligible to us and certainly will give rise to misapprehension.

The theory of total differentiation does not meet our approval at all. The author has treated the subject from the standpoint that the variables $x_1, x_2, \cdots x_n$ are all functions of some one variable. Instead of true total differentials, he gets *total derivatives*. The du in § 137 are not *total* differentials, but differtials of functions of one variable. In the differentiation of implicit functions the author assumes merely the existence of the partial derivatives. He should assume also their continuity. The form of demonstration is bad, as it requires him to assume (tacitly) the existence of the very thing he is seeking, viz., dy/dx.

In the treatment of envelopes, § 141, the author does not as usual give sufficient conditions for the validity of his reasoning, but contents himself with the vague statement in a footnote that the process is all right 'in all applications made in this book.' This blemish, which a few lines will remedy, should be removed in another edition. The definition of an infinite series given in § 147 is not felicitous. In avoiding the lax definition usually given the author has gone to the opposite extreme. The simplest way seems to be to consider

$$a_1 + a_2 + a_3 + , \dots \text{ in inf.}$$

as a symbol to which a meaning is attached as to other symbols, as $> < =$, etc. The solution of Ex. 3, § 152, is not quite rigorous, as it postulates the covergence of G. In § 160 *undefined* arithmetical operations are performed on series.

We can not agree with the author that the remainder in Taylor's series for several variables is too complicated to be given. The treatment of maxima and minima can be made much more complete without complications or difficulty. The reasoning given at the bottom of page 248 can be made not only 'plausible,' but entirely conclusive, using no more space that that required by the author.

In the reduction of indefinite integrals the author proves the trivial formulæ

$$\int (du + dv - dw) = \int du + \int dv - \int dw,$$

$$\int a dv = a \int dv,$$

but omits entirely the demonstration relative to the transformation of the variable. This is all the more surprising as this transformation is constantly employed, even in establishing important theorems. Two chapters, XXIX. and XXX., are devoted to definite integrals. In the first we arrive at the notion of a definite integral by means of the notion of area; in the second, by means of the limit of a sum. In our opinion the first treatment is not only superfluous, but should be entirely omitted on several counts.

The relatively few blemishes in this work, the reviewer is glad to state, will be removed in the next edition. James Pierpont.

Yale University.

The Study of the Atom, or the Foundations of Chemistry. By F. P. Venable. Easton, Pa., The Chemical Publishing Co. Pp. 290.

The history of an important scientific theory is an interesting study, where it is possible, as it often is, to trace the orderly development of that theory from stage to stage. The evolution of the atomic theory is a subject which has claimed the attention of many writers, and the story has been told so often and so well in works on the history of chemistry, that one wonders whether it is not familiar to most chemists. A careful perusal of this book does not disclose any new point of view, or anything new in the method of treatment, though the matter is generally presented in a satisfactory manner, especially Chapter V., which deals with the periodic system. In the last chapter of the book the author considers the most recent hypotheses regarding the constitution of matter by J. J. Thomson, Rutherford and others. The book is generally clear, conservative in tone and, on the whole, well-proportioned, though 75 pages, or one fourth of the contents, seems rather too much to devote to the conception of the atom before the time of Dalton, especially as this material must be taken entirely from secondary sources. The book may be commended as a good summary for students. E. T. Allen.

SOCIETIES AND ACADEMIES.

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

The section was called to order at 8:15 P.M., November 21, 1904, with Vice-president Kemp in the chair and forty persons present.

The first paper of the evening was by Professor J. J. Stevenson, upon 'The Island of Spitzbergen and its Coal,' and was illustrated by lantern slides. In introducing his subject, the speaker described briefly the coast of northern Norway and its geology, and referred in some detail to Bergen, Hammerfest and other cities. Spitzbergen was then taken up, and its coals and their geological relations were passed in review. The coal beds are of Jurassic age, and the coal is peculiar in that it partakes of the characters of the lignites as well as of the true coals.

The second paper on the program was by Professor James F. Kemp, on 'The Titaniferous Magnetite in Wyoming.' On account of the lateness of the hour, the speaker presented his topic only in abstract. The magnetite occurs in two places, fifteen and twenty miles north of Laramie, Wyoming, the former and smaller occurrence being near the Shanton ranch, the latter and larger being on Chugwater Creek. Both are in wall-rock of anorthosite which is practically indistinguishable from anorthosite occurring in the Adirondacks. The ores range from 20 per cent. to 40 per cent. TiO_2. Thin sections show that they contain green spinels, and one slide presents much olivine. They can be most reasonably explained as intrusive dikes. In this view the speaker agreed with Waldemar Lindgren, who has published a brief note regarding them.

JAMES F. KEMP,
Secretary pro tem.

THE section held a special meeting December 2, 1904, with Vice-president Kemp in the chair and two hundred members and visitors in attendance. The meeting was called to order at 8:25 P.M. and the program of the evening was at once taken up. This consisted of a lecture by Professor Albrecht Penck, of the Imperial University at Vienna, who is an honorary member of the academy.

The speaker discussed 'The Glacial Surface Features of the Alps,' and gave a brief summary of some of the results of the twenty years of masterly work which has been done by him and under his direction in the Tyrol. Professor Penck described in popular language the nature of the valleys of the Alps and showed by means of lantern slides and a diagram how the glaciers have widened and deepened portions of their rocky basins and produced lakes.

After a vote of thanks to the distinguished guest of the evening, the section adjourned.

EDMUND OTIS HOVEY,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 592d meeting was held December 10, 1904.

The first paper was read by invitation by Mr. H. H. Kimball, of the Weather Bureau, on 'Variations in Insolation and in the Polarization of Blue Sky-light, during 1903 and 1904.' Observations with an Angström pyrheliometer have been maintained by the Weather Bureau at Washington since April, 1903. Comparison with previous observations at Providence, R. I., and Asheville and Black Mountain, N. C., indicate that the quantity of solar radiation reaching the surface of the earth on clear days during 1903 was considerably less than during 1902 and 1904, the deficiency from April to September being 16 per cent. as compared with 1902, and 9 per cent as compared with 1904.

Observations with a Pickering polarimeter indicate that there have been corresponding fluctuations in the polarization of blue sky-light, the percentage of polarization at a point on a vertical great circle passing through the sun and 90° from it, having averaged 49.6 per cent. from May to October of 1904, as compared with 40.6 per cent. during the same months of 1903.

The work of the astrophysical observatory of the Smithsonian Institution and numerous European observations were quoted, showing similar deficiencies in insolation, in the transmissibility of the atmosphere, and in the polarization of blue sky-light, during 1903.

The subject was considered to be one well worthy of investigation by meteorologists.

Mr. J. F. Hayford, of the Coast and Geodetic Survey, presented some recent results on 'The Computation of Deflections of the Vertical from the Surrounding Topography.'

Deflections may be due to irregularity of density within the earth or to attraction of parts of the earth above the surface of the mean spheroid. By an ingenious method, partly graphical, the author had found it practicable to take account of the influence of all known topographical features on the plumb-line at more than 200 stations; it is usually necessary to consider all the land-masses within 2,500 miles of the station. When these computed deflections from known causes are combined with the deflections found from geodetic measurements, the quantities to be accounted for by irregularities within the earth's surface are usually much greater than had been supposed heretofore.

Charles K. Wead,
Secretary.

MICHIGAN ORNITHOLOGICAL CLUB.

The Michigan Ornithological Club held its last quarterly meeting for 1904 at the Detroit Museum of Art on December 2. The following program was presented:

P. A. Taverner: 'Re Kirtland's Warbler.'

A. W. Blain, Jr.: 'Some Phases of the Life History of the House Wren.'

J. Wilbur Kay: 'Remarks on the Cowbird.'

Dr. P. E. Moody: 'Nesting of the Blue-gray Gnat-catcher in Wayne and Oakland Counties, Michigan.'

J. Claire Wood: 'Notes on a Great Horned Owl in Captivity.'

A. B. Klugh: 'Summer Birds of Puschlinch, Lake Ontario.'

The following were presented by title:

Professor Walter B. Barrows: 'Birds of the Beaver Islands, Michigan.'

Dr. Morris Gibbs: 'Bird's Nesting.'

Wm. H. Dunham: 'A Preliminary List of the Birds of Kalkaska County, Michigan.'

Professor Frank Smith: 'An Unusual Flight of Sparrow Hawks in Michigan in 1904.'

Chas. C. Adams: 'A Natural History Expedition to Northern Michigan.'

The next meeting of the society will be held on March 3, 1905. A. W. Blain, Jr.

DISCUSSION AND CORRESPONDENCE.

INTERESTING AND IMPORTANT FACTS.

In Powell's 'Truth and Error' a philosophic distinction is made by giving special definitions to the terms *property* and *quality.* A property is an essential characteristic considered in itself; a quality is a characteristic considered in relation to man. Thus the ductility of iron is a property; its utility a quality. The form and coloration of a tree are properties; its beauty or ugliness is a quality. Iron's property of ductility, when thought of in connection with human needs, is a factor of its quality of utility; and the properties of the tree, when viewed from the standpoint of man's esthetic sense, are qualities. This simple distinction is of far-reaching application, because properties are the domain of science and qualities the domain of art. Pure science (with a reservation in respect to anthropology) is not at all concerned with qualities, and when the investigator deals with them he passes into the field of applied science, or the arts. Failure to recognize this distinction leads to much confusion of thought and expression.

One of the milder or less harmful, but at the same time most conspicuous, manifestations of this confusion is connected with the word *interesting.* Not unfrequently an essay ostensibly and mainly scientific will contain the statement that an object, or relation, or other phenomenon is 'interesting,' the context indicating that interest is supposed to inhere in the phenomenon. As a matter of fact, interest is a mental attitude of the observer, and the adjective 'interesting,' though applied to the phenomenon, describes only the observer's relation to it. There are, of course, many legitimate uses of the adjective, and some of these occur in scientific writings. When an author, for example, declares that the insect habits he is about to describe are interesting to students of the psychology of the Bombocoreidæ, it is clear that he does not deceive himself by supposing that he has named a property of the phenomena.

Something similar may be said of *important, valuable,* etc., when employed in scientific description. In common with *novel, pertinent, significant,* and the like, they indicate the relations of phenomena to the condition of human knowledge. Just as each observed fact has at some time, temporarily, the quality of novelty, so each fact and inference may in some phase of the progress of knowledge serve to explain the previously unexplained, and thus have importance or comparative value. Apart from such temporary and humanistic relations, all facts are equally important or equally unimportant. When, therefore, an author makes the bald statement that a fact is 'important,' he ascribes to it a quality and not a property; and he is self-deceived if he thinks of the importance as an essential characteristic.

It conduces to clear thinking as well as clear writing if one fortifies the use of 'interesting' or 'important' by pointing out the relation which endows the indicated fact with interest or importance. When that has been done the need for the adjective often disappears; and if it can not be done, the adjective is a meaningless platitude.

G. K. Gilbert.

Washington, D. C.

SPECIALIZATION, IGNORANCE, AND SOME PROPOSED PALLIATIVES.

I beg leave to use the columns of Science to express a few ideas which may strike some readers as strangely naïve, but which have been incubating in my brain for a term of years, and must now at length find some mode of deliverance. I speak as one of that large class of unfortunates who aspire to contribute a few small stones to the temple of knowledge, but who are forced to give so much time to purely routine work that little is left for better things. And that precious little remnant of our time—how do we employ it? Largely in misspent energy and unproductive efforts; not in the quest of knowledge, but of the means of acquiring knowledge; not in learning facts, but in learning how to learn! After we have deducted the time spent in purely mechanical operations, in developing our technique and in digesting the ever-growing literature of our particular little fraction of a sub-science, how much remains of those brief moments spared from the struggle for bread? Is it a wonder that 'general culture' suffers, when even our sister sciences are neglected, or that specialization so often results in an intellectual isolation, fatal alike to the scientist and the man? *Platitudes?*—of course they are! Who has not deplored these conditions? But we all resign ourselves to them as inevitable, just as we do to a social order which tolerates boss rule, 'Standard Oil' and the inheritance of poverty or riches. Who has not wished to halt the march of discovery long enough to allow himself to 'catch up'? And, seriously, would it be a misfortune if we should be compelled to pause for a moment in the exploitation of new facts, and properly assimilate the ones we have? But this is not the burden of my modest message.

One can not but marvel at the absence of any adequate bureau of exchange among specialists in different fields of knowledge. We have our societies, it is true, where papers are presented which are oftentimes too technical even for the limited circle of members—all fellow specialists in a single science. We have our journals, congested with contributions, good, bad and indifferent. But which one of us can follow all the technical journals of his own specialty, even though his path be blazed by international bibliographic catalogues? We have our reviews and year-books and Jahresberichten, in which the topics treated are apt to gain in technicality in proportion to the degree of abridgment. Various semi-popular periodicals doubtless do a splendid work in making accessible some of the more general conclusions of science, but their contents are necessarily fragmentary and uncoordinated.

In our higher educational institutions we find specialists engaged in two chief pursuits: giving instruction to students, and conducting research. A third possible function of the faculty seems never to be fully recognized, namely, mutual enlightenment. Why is there often such utter isolation between various departments? Why has there not been established any recognized clearing-house for the exchange of expert knowledge? Much of such exchange doubtless occurs in a desultory and haphazard way, through ordinary social intercourse, so that a man of requisite personal and social gifts may receive and impart much of value. And doubtless various public lecture courses do something toward meeting this need. But why not organize in every university an inter-departmental congress, in which members of the various departments shall present, in as palatable form as possible, the problems and discoveries of present interest in their respective branches of learning? On the face of things it would seem that such an arrangement would necessarily result in an added stimulus and a broader horizon for each member of the staff, and a greater solidarity for the whole.

An objector will doubtless be prompt to point out that the above plan, though plausible on paper, would, for one reason or another, be quite impossible in practise. I can only reply that no suggestion which offers the least hope of lessening the baneful effects of over-specialization ought lightly to be dismissed. Nor should I be surprised by the quite different criticism that my idea utterly lacks novelty, that it has long since been threshed over by educational experts, perchance received a fair trial somewhere. In reply, I could but cite my own ignorance of these facts as a fine illustration of the very conditions which I have deplored.

But there is another idea which I cherish just as tenderly—one equally chimerical, mayhap. It is nothing more nor less than the establishment of a sort of human encyclopædia as an adjunct to our libraries. How much of our ignorance is due to the inaccessibility of knowledge! How many questions we allow to pass unanswered, rather than grope blindly amongst unfamiliar volumes! The thought lies near to hand that some one could save us that trouble—some one who would not have to grope. But who? The plain man sends a query to his daily paper, and receives an answer which we hope is more trustworthy than the editorial opinions or news items on the same sheet. Or he may have the temerity to write to an expert, who may be good-natured enough to reply. But where in our educational system is the man or body of men whose recognized function it is to answer questions? Teachers we have by the thousand, employed to impart knowledge in accordance with certain more or less stereotyped courses of study, but where are the men whose business it is to tell us just those things for which we happen to be seeking? The scientific departments of our government, it is true, give much expert advice on various matters, in reply to correspondents, and here, indeed, we find our most instructive models. But their scope is obviously limited.

Suppose that one of our great libraries were to employ a staff of consulting experts, men of the rank of college professors, whose duty it should be to furnish definite bits of information in response to legitimate questions, or at least to guide the seeker on his way. The cost of maintaining such a library would doubtless be vastly increased, perhaps doubled —I leave that for the professional librarian to compute. But over against this added cost could be set the untold hours saved to the student or the layman, searching in unfamiliar fields, and the vastly greater facility of the diffusion of knowledge. My suggestion might easily be caricatured into the proposal that the learner should henceforth dispense with books. Quite otherwise, it is my main object to enable him to do more reading and less groping; to peruse pages of text, instead of card catalogues and tables of contents; to economize time, and to minimize the loss of energy through friction.

In the case of a university library, could not such relations be maintained with the faculty as to permit of members of the latter body being called in for expert advice, not sporadically, but as a part of the organic system? This would throw an additional burden upon the teaching staff, which would, of course, need to be increased numerically. But would not such a function compare favorably in usefulness with the teaching of various prescribed subjects to apathetic learners? To the overburdened specialist, such a system would serve the same end as the plan first proposed, giving him more ready access to other fields of thought, and minimizing the evils resulting from the increasing differentiation of knowledge.

But here again I fear that the experts may smile at my modest suggestion, either as being utterly impracticeable, or as quite devoid of novelty or originality. If so, I can but humbly acknowledge my ignorance, adding once more that this unhappy condition merely strengthens my case!

FRANCIS B. SUMNER.

ULTRA-VIOLET LIGHT IN PHOTO-MICROGRAPHY.

TO THE EDITOR OF SCIENCE: Apropos of Dr. Cleveland Abbe's letter in a recent issue of SCIENCE, I would call the attention of your readers to the fact that the developments in the use of utra-violet light in photo-micrography with apparatus designed at Jena is described in some detail in *Engineering* (London), for December 2, 1904, page 760.

CLIFFORD RICHARDSON.

HOW DOES ANOPHELES BITE?

IN a recent number of SCIENCE Professor Washburn, in the course of some remarks on the mosquito exhibit at St. Louis, prepared by me for the New Jersey State Museum, questions the accuracy of a figure of *Anopheles* in the act of biting. I do not understand him to say positively that the figure is inaccurate, only that it had been his belief that the biting position resembled the resting position more nearly. The figure in question, which was a large colored one calculated to attract the attention of the passers-by, was intended to duplicate the picture given by Nuttall and Shipley in their work on *Anopheles*, its structure and habits. It is really a very accurate copy of their plate and the position in my chart is just exactly as published. This is an explanation, not a justification; if the figure is wrong it should not have been put on exhibition in that way; but is it wrong?

When I read Professor Washburn's note I tried to recall my own experience with *Anopheles*. I recall distinctly, watching specimens bite on several occasions, and particularly at Cape May, where *Anopheles crucians* was very plentiful in 1903 and bit freely during the early morning hours. This habit is unusual in the genus and attracted my attention, so that I gave the insects every opportunity to bite; yet, while I can recall distinctly all the surrounding circumstances, I do not recall just what position the insect assumed when biting. I questioned in turn every member of the field and office force, and found that they were equally uncertain in the matter. All of them had been bitten and all of them were able to recall specific occasions where they watched the insect bite, yet none of them would say positively just what the biting position of the insect really was.

During the summer of 1902 Dr. Herbert P. Johnson studied *Anopheles* for me near Newark, N. J., and kept a number of the insects in confinement, allowing them to bite from time to time, and of course watching the operation. I wrote him to the St. Louis University, where he is at present engaged, and received an answer as follows: "While I have not so distinct a mental picture of the operation as I would like to possess I am very confident he [Professor Washburn] is wrong. The biting attitude he mentions would be a most extraordinary one, and for this reason: it is obvious that the mosquito pumping apparatus must penetrate the epidermis before any blood can be drawn and the epidermis is made up of many layers of cells. To thrust its lancets in obliquely is evidently to encounter more resistance, do more work, and with less prospect of success than to thrust vertically through the many layers of cells of the epidermis. If there is an easy way of doing a thing, nature does not ignore it for a more difficult way. The only way in which *Anopheles* could introduce its bill vertically and still keep it in line with its body, would be for the body to assume the vertical position, which I have never seen it do. It is always somewhat oblique."

Mr. Henry L. Viereck, who spent the entire summer at Cape May for me and who especially studied *A. crucians*, writes: "In biting *Anopheles crucians* stand like *A. punctipennis* as shown in Berkeley's figure 17; that is, with the body and beak nearly in a straight line and at an angle somewhat greater than 60° to the surface. The disposition of the legs during the act I can not recall exactly, but I feel quite sure they were very much as in the figure I have referred to."

These communications were hardly satisfactory and we looked up every reference that was available, only to find that no one who has written upon the subject, whose works we had in hand, spoke definitely on the position of *Anopheles* in actually biting. Nuttall and Shipley describe the bending of the proboscis, and in fact the entire mechanism of biting, and other authors are almost as detailed as they; but to the position, no one seems to refer.

In the hope of getting other information I wrote to Dr. L. O. Howard, and received this reply: "I never saw *Anopheles* bite but once, and that was in the dusk while I was sitting on the platform of a railroad station at Fresno, Cal. My impression was that the beak was not in the plane of the body; but that the head was bent downward. Mr. Pratt, when he was living in Virginia, was frequently bitten by *Anopheles,* and tells me that he has a positive recollection that the head was bent downward and that the hind legs were curved upward."

I wish it distinctly understood that this is not a contribution to knowledge. It is an illustration of how many men may make observations in certain lines and absolutely ignore the most obvious points. It is also intended as a suggestion to those who may have made and recorded direct observations on this point, to publish their experiences.

John B. Smith.

Rutgers College,
New Brunswick, N. J.
December 22, 1904.

SPECIAL ARTICLES.

THE DISCUSSION IN THE BRITISH PARLIAMENT ON THE METRIC BILL.

There lies before us a reprint from the Parliamentary Debates in the House of Lords on February 23, 1904. The order of the day was the second reading of the bill for the compulsory introduction of metric weights and measures into the United Kingdom of Great Britain and Ireland. We will make some extracts from the discussion which will show the present conditions over there and which will interest us because it is universally admitted that the adoption of the metric system by one branch of the English race will secure its adoption by the other. The reading was moved by Lord Belhaven and Stenton, but the principal advocate of the bill was Lord Kelvin. In order to show how great change had taken place in public opinion on the measure in recent years, as compared with the time not long ago when the chief argument of the opponents of the bill was that public opinion was not yet ripe for it, the noble lord presented petitions from thirty town and city councils, representing a population of over 8,000,000, from fifty chambers of commerce, thirty retail dealers' associations, forty-three trades unions representative of 300,000 workers, sixty teachers' associations, inspectors of weights and measures in eighty districts and a large number of individual signatures, bringing the total number of individuals represented to 333,000. A nearly equal number additional were promised within a week, the Liverpool Chamber of Commerce sending theirs separately by Lord Avebury, together with several chambers of agriculture. The difficulties alleged to be experienced by foreign countries in making the change were declared non-existent. His Majesty's representatives abroad at the time stated the change was made without much difficulty; though some countries were more rapid than others, there never had been any desire to return to the old system, and the adoption of metric weights and measures had assisted the development of trade. Switzerland commenced to use the metric system eighteen months from the passing of the law. There was no great difficulty found there in the towns, but it was some time before it was adopted in remote country places. In Germany it was adopted more quickly than anywhere else. Two years and one month were allowed, and the interval thus granted was sufficient to insure the adoption of the new system in all details; it was an accomplished fact by the day named. There is no desire to go back to the old system, and the change has contributed to a rise of German trade and commerce, foreign trade deriving much benefit. There are some persons who object from a dislike to mental effort, and who prefer to muddle on with the British system described by the prime minister as 'arbitrary, perverse and utterly irrational.' To these I reply that the metric system is bound to be adopted sooner or later, and that personal inconvenience for a few days should not be allowed to interfere with a measure calculated to promote the trade and prosperity of the country.

We have had nine years of permission to use the metric system without thereby rendering ourselves liable to punishment for a breach of the law, and experience has proved that the change from the system that has been so long in use in this country to a new system can not be made over the whole country voluntarily. *It is a case for compulsion,* and I think the legislature will be thanked by the country for having applied compulsion. In Germany, France and Italy no inconvenience has resulted from the introduction of the metric system, and there has never been such a thing as a complaint. The change in Germany occupied only two years. I have in my hands a statement by Sir Wm. Ramsay, in which he wrote: "I was in Germany during the change there; it gave no trouble whatever and was recognized within a week."

It is interesting to know that the decimal system, worked out by French philosophers, originated in England. In a letter dated November 14, 1783, James Watt laid down a plan which was in all respects the system adopted by the French philosophers seven years later, which the French government suggested to the King of England as a system that might be adopted by international agreement. James Watt's objects were to secure uniformity and to establish a mode of division which should be convenient as long as decimal arithmetic lasted, a thing we may consider as absolutely settled.

I hope this bill will be sent forward with full pressure to the other house, 333 members of which have declared themselves in favor of it and ready to support it.

In introducing the bill, Lord Belhaven and Stenton recalled some of the testimony given in the blue book, known as the 'Report on Weights and Measures,' made to the house of commons July 1, 1895. That report contained three recommendations, viz:

(*a*) That the metrical system of weights and measures be at once legalized for all purposes.

(*b*) That after a lapse of two years the metrical system be rendered compulsory by act of parliament.

(*c*) That the metrical system of weights and measures be taught in all public elementary schools as a necessary and integral part of arithmetic, and that decimals be introduced at an earlier period of the school curriculum than is the case at present.

Of these recommendations the first was complied with by the permissive act of 1897, which made the use of the metric system in trade lawful (it was previously illegal to use it), and the third was adopted under the educational code of 1900. The second is in the bill now before us. An important point in the history of this subject is, that in August, 1902, there was a colonial conference attended by all the premiers of the self-governing colonies, which passed this resolution: "It is advisable to adopt the metric system of weights and measures for use within the empire, and the prime ministers urge the government represented at this conference to give consideration to the question of its early adoption." And since that time the colonies have been pushing the matter with great earnestness.

The saving of time in education by the use of the metric system is not only in the teaching of the tables, but the whole system of compound addition, subtraction, multiplication and division, and the system of computation called 'practise.' Last year inquiries were made of head masters of schools on this subject, and 197 sent replies, of which 161 said the saving would be one year, 30 said it would be two years, and 6 said that it would be three years. The senior mathematical master of Edinburgh high school wrote: "An average scholar would save at least a year and a half, probably two. I conceive it to be not only a saving of time, but an economy of mental effort which is incalculable."

The commercial value of the metric system has been reiterated by British consuls in foreign countries for many years. In the *Board of Trade Journal,* February 15, 1900, the British consul at Amsterdam says: "The iron and steel manufacturers' unions of Germany have adopted a uniform system of dimensions based on metric weights and measures. The classifications are making more and more progress in Germany, not in the iron trades alone, but in other manufactures. In the future Germany, and the continent generally, will have a constantly increasing advantage over British manufactures in foreign countries, unless the metric system be fully and entirely adopted by Great Britain. I may mention as an undoubted fact that the preference which Germany has obtained here over Great Britain regarding railways, bridges and other railway material is mainly owing to the existence of this metric classification."

Other items in the discussion were that Russia had directed her iron and steel works to alter their rolling machinery so as to produce only rods, rails and sheets on a metric scale, that 45 per cent. of British exports were to non-metric countries and 55 to metric countries (66 per cent. of United States imports are invoiced in metric measures). At present Britain has eighty different denominations represented by 155 different kinds of weights and measures, which by this bill will be reduced to thirty denominations represented by fifty-three different kinds of weights and measures, or only one third the present number.

The bill was read a third time in the house of lords, May 17, and referred to a select committee to arrange the practical details necessary to carry it into effect. It was then passed and sent to the house of commons, and read the first time. This discussion showed that there was a very great popular demand in England for the introduction of the metric system, more than there is in this country at the present time. England is a small country, and the adjacent countries, France, Belgium, Holland and all Scandinavia use the metric system, hence people in general are brought much more in contact with it than in the United States, where we only touch the metric system directly in Mexico, and even this contact is having a decided effect in making the system familiar to our citizens.

The principal arguments now relied on by the opponents of the metric system here are that it has not displaced the old measures in countries where it has been legalized, and that its introduction would be a matter of enormous expense. Any one who has had personal experience in foreign travel, or who will take pains to inquire of any of the thousands of emigrants that come among us, will soon convince himself that the metric system is the principal system in actual use in trade and commerce in European countries.

The very large number of working people who appear in Lord Kelvin's list as advocates of the metric system are drawn to its support not only by the actual contact with metric-using nations, but also by the handicap imposed by the British system on getting a useful practical education. This point is increasing in importance since the complete change of both British and American text-books to the metric system. The absurdity is patent of requiring the workman to use an old system different from that in which all knowledge is gathered by the original workers and communicated to their students, and of which the great mass of operatives are ignorant. The operatives themselves, as soon as they become fully aware of it, demand the possession of this key to knowledge and the higher education.

We have heard a great deal in the last three years about the enormous expense of adopting the metric system. The great majority of people who talk about this expense do not know anything about the actual use of the metric system, and have not brought one scrap of testimony that supports their views from countries that have made the change, while most of those who advocate the system are in the actual use of it as teachers, investigators, etc. The opponents of the system are in the position of a man who condemns a tool without ever having used it. Now Lord Kelvin said in his argument before the lords that "last year inquiries were made of head masters of schools, 197 sent replies, of whom 169 said the saving of time by teaching the metric system would be one year, thirty said it would be two years and six said it would be three years. The senior mathematical master of Edinburgh high school wrote, that in view of the wearing out of teachers and scholars in obtaining a knowledge of the British system, the adoption of the metric system would result in not only a 'saving of time, but an economy of mental effort which is incalculable.'" Lord Kelvin's argument applies with even more force to the United States. The committee on coinage, weights and measures say in their report No. 1701, April 21, 1902, made to the first session of the fifty-seventh congress: "When we consider 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 annum, 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 that as a whole does not agree with any other nation in the world, and which does not offer any advantage whatever to compensate for its complexity. Surely the children and teachers of the country are worthy of quite as much consideration as the temporary personal and pecuniary interests of some manufacturers, who have failed to furnish, by either themselves or their representatives, any evidence whatever that the manufactures of Germany or Switzerland have or did suffer any loss whatever by the recent adoption of the metric system in those countries. No one in this country has proposed to affix any penalties legal or otherwise to the use of the customary system, what we do want, and are entitled to work for as citizens, is that the government shall adopt in all its work the metric system, which is already the international system for a majority of the civilized world."

The *American Machinist*, of January 14, sums up the matter by saying what is true: "The testimony of men who have had experience in all parts of the world with both systems in the manufacture of machinery is practically unanimous, that most objections to the metric system are based upon purely *imaginary difficulties*, and that the testimony of men who have not had such experience *does not amount to anything*.

We are constantly asked what advantage will the metric system be to this or that particular business. The whole community is larger than any part of it, and is entitled to first consideration. We have shown above that one of the largest and most important activities in this country, the business of education, will be enormously benefited, and every other trade or business will also be benefited, by the increased effectiveness of mental effort in every direction which is the necessary consequence of substituting a simple and rational system for the complex, irregular and barbarous system now in vogue.

WILLIAM H. SEAMAN.

CURRENT NOTES ON METEOROLOGY.

TEMPERATURES IN THE FREE AIR.

THE valuable data concerning the temperatures in the free air obtained during the daily 'soundings' made at the Prussian Aeronautical Observatory at Berlin, are discussed by J. Homma in the *Meteorologische Zeitschrift* for October, 1904. The observations considered are those of the year 1903, and they are grouped by seasons and by good and bad days, the temperatures being summarized for different altitudes. It is to be noted that the ascents were made at different *morning* hours, between nine and twelve, and, therefore, the mean obtained is not to be regarded as accurately representing the conditions during the twenty-four hours. The vertical temperature gradients for the four seasons show a very slow decrease up to 2,000 meters in winter, and a rapid decrease in spring and summer. The average rate of temperature decrease for the year is about 1.3° per 100 meters near the surface, but decreases aloft, up to about 2,000 meters (0.9°), and then increases with altitude. The mean decrease of temperature for May, June and July between the surface and 500 meters is more rapid than the adiabatic rate of 1.8° in 100 meters.

BAD WEATHER, GOOD ROADS AND FARMERS.

PROFESSOR A. P. BRIGHAM, in the *Bulletin of the American Geographical Society* for December, emphasizes the need of good roads in the United States, and points out how great is the handicap of bad roads to farmers and to railroads. In this connection, the weather is an important factor, for when the roads are bad, the farmer is greatly restricted in the times when he can go to market. If high prices coincide with a period of wet weather and deep mud, the farmer may lose his opportunity of getting his crops to market. In France, cold or stormy days are often used for hauling to market, but American farmers usually have to use for hauling the days which are the best for work on the farm. Railroad receipts often suffer a serious falling off when the weather is severe, and when the country roads are in such condition that farmers can not haul their produce to the train.

MONTHLY WEATHER REVIEW.

The *Monthly Weather Review* for September, 1904 (dated November 19), contains the following articles of general interest: H. Elias, 'A New Theory of Fog Formation' (translated from the German); J. H. Spencer, 'Three Notable Meteorological Exhibits at the World's Fair' (the U. S. Weather Bureau, the German and the Philippine Weather Bureau exhibits); and the following notes: 'Meteorology in Roumania'; 'Observations for Twelve Months in Lassa' (data obtained by M. Tysbikov, a Russian, who resided in Lassa from August 15, 1900, to August 22, 1901); 'Observations at the Franco-Scandinavian Station for Aerial Soundings' (from *Comptes Rendus*); 'Wind Velocity and Ocean Waves' (from a recent paper by Cornish).

NO SECULAR CHANGE OF CLIMATE IN TRIPOLI.

Vicomte de Mathusieulx, in an account of his expedition to Tripoli (*Bull. Amer. Geogr. Soc.*, December, 1904), states it as his opinion that there is no reason for supposing any secular change of climate to have occurred in that region, although others have taken the opposite view. The Latin texts and monuments seem, to this writer, to establish the fact that so far as the atmosphere and soil are concerned, everything is just as it was in antiquity. The present condition of the country is ascribed to the idleness of the Arabs, who have allowed innumerable wells to become choked and the vegetation to perish. "In a country so little favored by nature, the first requisite is a diligent and hard-working population. The Romans took several centuries to make the land productive by damming the ravines and sinking wells in the *wady* beds."

CLIMATIC CHANGE IN THE LAKE CHAD REGION.

The evidence from the region between the Ubangi River and Lake Chad, studied by M. Aug. Chevalier in 1902–3, is, however, believed to point towards a progressive desiccation there (*La Geographie*, May, 1904). M. Chevalier thinks it probable that a great river once flowed north across the Sahara to the Mediterranean, and that Lake Chad was merely a back water. Vegetable and animal remains indicate an invasion of the Sudan by the Saharan climate, and Neolithic relics indicate the former presence of prosperous communities. The change is not a regularly progressive one, for Lake Chad sometimes spreads beyond its usual bed as a result of several years of heavy rainfall. Since 1897 the waters have continued to fall. After a drought in 1902, Lake Fittri dried up in the following year, and hippopotami which inhabited it went elsewhere.

KITE METEOROLOGY OVER LAKE CONSTANCE.

Dr. Hergesell has contributed to a recent number of the *Beiträge zur Physik der freien Atmosphäre* an account of the observations made by him with kites on the Lake of Constance, the flights being made from a motorboat, loaned by Count Zeppelin, during the years 1900, 1902 and 1903. The observations show that inversions of temperature and of humidity frequently occur in the free air which are not exhibited by the observations made at mountain observatories.

R. DeC. Ward.

THE FIRST OBSERVATIONS WITH 'BALLONS-SONDES' IN AMERICA.

As is known to many readers of Science, there have been despatched in Europe frequently during the past ten years *ballons-sondes*, or small balloons carrying only instruments that record automatically the temperature and pressure of the air, thus enabling the temperatures to be determined at the successive heights reached, the place and time at which the balloons fall indicating approximately the direction and velocity of the upper currents. The 'aeronautical concourse' of the St. Louis Exposition afforded an opportunity to undertake these investigations in this country. Accordingly, the work was taken up by Mr. A. Lawrence Rotch, director of the Blue Hill Observatory, in cooperation with Col. J. A. Ockerson, chief of the Department of Liberal Arts at the Exposition, and a series of very satisfactory experiments has just been completed.

The balloons used in the experiments are the closed rubber balloons devised by Dr. Assmann, director of the Prussian Aeronautical Observatory. These balloons are inflated with about 100 cubic feet of hydrogen gas; they expand in rising until they burst, and then the attached parachute moderates the fall. In some cases two balloons, coupled tandem, were employed, and, as only one balloon bursts, the other is borne slowly to the ground and serves to attract attention. The instruments, which were furnished by M. Teisserenc de Bort, of Paris, record the temperature and barometric pressure upon a smoked cylinder, turned by clockwork; and the lightest of them in its basket weighs about one and one half pounds. A notice attached to each requests the finder to pack the instrument carefully in a box and return either to St. Louis or to Blue Hill, with promise of a reward for the service.

Owing to delays in obtaining the gas and apparatus, the experiments were not begun until the middle of September, during which month four ascensions took place. All of the balloons fell within a radius of fifteen miles, about fifty miles east of St. Louis. Twice the height of nine or ten miles was attained where a temperature of 68° F. below zero was recorded. These experiments were conducted by Mr. S. P. Fergusson, of the Blue Hill Observatory staff. Another series of ten ascensions was executed by Mr. H. H. Clayton, meteorologist at the Blue Hill Observatory, during the last part of November and the first days of December, mostly after sunset, in order to avoid the possible effect of insolation. Fortunately, all these balloons were also recovered, though the stronger upper air currents carried them further from St. Louis, three of them traveling more than two hundred miles, and two, at least, with a speed exceeding one hundred miles an hour, the direction of every balloon being toward the easterly semi-circle. Ten of the fourteen ascensions furnished good records, and the reduction of the later ones reveals lower temperatures than in September, for example, 72° below zero at the height of seven and three quarters miles on November 25, and 76° below at six and one quarter miles on the following day.

The fact that all the balloons were recovered indicates the excellent topographical situation of St. Louis for despatching them, and Mr. Rotch expects to make another series of ascensions there this month, in order to obtain the temperatures of the upper air in midwinter.

SCIENTIFIC NOTES AND NEWS.

THE Lavoisier medal of the Paris Academy of Sciences has been awarded to Sir James Dewar.

THE title of Correspondant de l'Ecole d'Anthropologie de Paris has been conferred upon Mr. George Grant MacCurdy of the Yale University Museum.

MR. FREDERIC EMORY, chief of the Bureau of Trade Relations of the Department of State, has presented his resignation to take effect on March 31.

DR. HORACE JAYNE has resigned the directorship of the Wistar Institute of the University of Pennsylvania.

LORD KELVIN has accepted the nomination of the council for the presidency of the London Faraday Society, in succession to Sir Joseph Swan.

PROFESSOR G. SERGI has been made president for the International Congress of Psychology to be held at Rome from April 26 to 30 of the present year.

LIEUTENANT-COLONEL A. KEOGH has been appointed director general of the British Army Medical Service.

At the meeting of the California Academy of Sciences, recently held in San Francisco, Mr. Walter K. Fisher, assistant in the department of zoology, of Stanford University, delivered a lecture entitled 'Bird-life on a Tropical Island of the Pacific.

Dr. Otto Nordenskiold lectured on his Antarctic exploration before the French Geographical Society on December 16.

Plans have been made to erect a memorial to Dr. Franz Riegel, professor of medicine at Giessen, who died last August.

Nature states that it is proposed to establish in the University of Liverpool a memorial to Mr. R. W. H. T. Hudson, late lecturer in mathematics, whose brilliant career was so tragically cut short at the end of last September. The memorial will probably take the form of an annual prize in mathematics, to be awarded for distinction in geometry, the subject in which Mr. Hudson's work chiefly lay.

Dr. Benjamin West Frazier, professor of mineralogy and metallurgy at Lehigh University since 1871, died as the result of a stroke of apoplexy on January 4, at the age of sixty-three years.

Mr. C. C. Barrett, an English entomologist, has died at the age of sixty-eight years.

Sir Lothian Bell, F.R.S., the author of works on metallurgy, died on December 20 at the age of eighty-eight years.

The death is also announced of Professor Hermann Wilfarth, director of the Agricultural Experiment Station at Bernburg; and of M. Paul Tannery, author of works on the history of science.

Foreign exchanges state that the Circolo Matematico di Palermo intends to offer an international prize for geometry at the fourth International Mathematical Congress, which will meet at Rome in 1908. The prize will consist of a small gold medal, to be called the Guiccia medal, after its founder, and of 3,000 francs, and will be given by preference, though not necessarily, to an essay which advances the knowledge of the theory of algebraical curves of space. The treatises may be written in Italian, French, German or English, and must be sent to the president of the Circolo Matematico before July 1, 1907.

The New York *Evening Post* states that in pursuance of the written agreement between Harvard and New York Universities, to carry on for ten years a biological station in the Bermuda Islands, a supervising committee has been completed by the acceptance of a third member of the committee, Hugo Baring, who was nominated by the Royal Society of London, which is a contributor to the enterprise through the Bermuda government. Harvard University is represented on the committee by Hon. Charles S. Fairchild, ex-secretary of the United States Treasury, and New York University by Mr. William M. Kingsley, the treasurer of the university.

Mr. Andrew Carnegie has given $263,000 to the Maryland Institute School of Art and Design, thus doubling the assets of the institution. A new building will be erected to replace the one destroyed in the Baltimore fire. It is also stated that Mr. Carnegie has intimated to officials of the Franklin Institute, of Philadelphia, that if they can secure the Franklin fund amounting to about $155,000, in the hands of the Board of City Trusts, he will add an equal sum to the amount. The Franklin fund, £1,000, was left to the City of Philadelphia by Dr. Benjamin Franklin in 1790, to be used in making loans to young married artificers under certain conditions. No loans under the conditions have been made for years. The money will be used for the erection of a new building.

The Mexican Department of Agriculture is planning a series of meteorological stations to be connected by telegraph with the meteorological observatory in Mexico City.

Professor Boyce, of Liverpool University, has proposed to the Liverpool Chamber of Commerce a scheme for the establishment of a commercial museum and bureau of scientific information.

The new tuberculosis building at the Johns Hopkins Hospital, adjoining the general dispensary, will be formally opened about January 15. It is the gift of Mr. Henry Phipps, of Pittsburg, who gave $20,000 last winter, through Dr. Osler, for a separate dispensary for tuberculous patients.

Karlsruhe has followed the example of Charlottenburg in establishing a tuberculosis museum. Arrangements are being made by which parties of working people will be enabled to visit the museum from all parts of the country.

We learn from *The British Medical Journal* that a private citizen has placed in the hands of the government of the Grand Duchy of Baden a sum of $60,000 towards the foundation at Heidelberg of an institute for the study of cancer. The government has given a site for the purpose in the immediate neighborhood of the University Hospital, and has promised a grant for the maintenance of the institute.

The completed object-glass of eighteen inches clear aperture for the new observatory was formally delivered to the trustees of Amherst College on December 31 by Mr. C. A. R. Lundin, the maker and optical expert, representing the firm of Alvan Clark and Sons. The objective was brought to Amherst by Professor Todd and deposited in the college vault for safe keeping till the mounting is ready to be erected in the spring. The flint and crown disks were made by Mantois, of Paris, and were pronounced by Alvan Clark the finest pair of disks ever received in his shops. The optical work upon them, figuring, correcting and polishing, during the past two years, fully maintains the highest standard of excellence set by this firm in the forty-inch Yerkes telescope, the thirty-six-inch Lick telescope, the thirty-inch Russian object-glass, the twenty-six-inch at Princeton, and numerous others.

A Pacific Coast Biological Society was established at a meeting held in San Francisco on December 10. Its membership includes those who are carrying on research in zoology, paleontology, anatomy, physiology, psychology and botany. Meetings will be held four times a year. At the first meeting Dr. Jacques Loeb gave an address on heliotropism in animals. Professor H. Heath, of the Stanford University department of zoology, was elected president, and Professor W. J. V. Osterhout, of the department of botany at the University of California, secretary-treasurer.

A mathematical section of the California Teachers' Association was organized on December 26, 1904, at San Jose. Professor G. A. Miller, Stanford University, was elected president, and Mr. J. F. Smith, Campbell High School, secretary. The main object of the association is to arouse more interest in mathematical pedagogy by means of separate meetings for the discussion of recent mathematical movements.

The American Breeders' Association will hold its annual meeting at Champaign, Illinois on February 1, 2 and 3. Special sessions will be devoted to the following subjects: specific methods of breeding corn, wheat, apples and other plants; methods of improving short horns, dairy cattle and other breeds of live stock, breeding disease-resisting plants, Mendel's law, in-and-in breeding.

Mr. Francis Darwin has written the following letter to the London *Times:*

In an article on 'Greek at Oxford,' from a correspondent in *The Times* of December 27 occurs the remark 'It will be remembered also that Darwin regretted not having learnt Greek.'

I am at a loss to know on what authority this statement rests. If Darwin had any regrets on the subject of Greek it was when he found that in the two years intervening between leaving school and going up to Cambridge he had almost forgotten his classics, and had to begin again an uncongenial task in order to get a degree.

Darwin says of his education at Shrewsbury School: "Nothing could have been worse for the development of my mind than Dr. Butler's school, as it was strictly classical, nothing else being taught, except a little ancient geography and history" ('Life and Letters,' I., 31). He was, in fact, a victim of that 'premature specialization' which is generally referred to in a somewhat one-sided spirit, and from which the public schoolboy is not yet freed.

If the name of Charles Darwin is to be brought into this controversy it must not be used for compulsory Greek, but against it. In 1867 he wrote to Farrar, 'I am one of the root and branch men, and would leave classics to be learnt by those alone who have sufficient zeal and the high taste requisite for their appreciation' ('More Letters of Charles Darwin,' II., 441).

The Biological Society of Washington offers for sale to the highest bidder, prior to January 15, 1905, its entire accumulation of exchange publications, consisting of about 1,500 serials or parts of serials, pamphlets and volumes on all branches of natural history. An opening bid of $25 is already in hand. The collection will be sold as a whole, and bids for parts can not be accepted. For information apply to the secretary, Wilfred H. Osgood, Department of Agriculture, Washington, D. C.

Dr. Henry Fairfield Osborn, Da Costa professor of zoology in Columbia University and curator in the American Museum of Natural History, will deliver a series of lectures in February, at the Museum of Natural History, on 'The Evolution of the Horse.' The lectures will be given under the auspices of Columbia University in cooperation with the museum, on the first three Mondays and the first three Wednesdays of the month. The subjects are: 'The Horse as an Animal Mechanism,' 'The Horse in Relation of the Idea of Evolution,' 'The Fossil History of the Horse,' especially in North America; 'The Fossil History of the Horse Continued,' 'Existing Races of Horses, Asses and Zebras,' 'Probable Origin of the Domesticated Breeds of Horses.'

A colonial exposition will be held in Marseilles in 1906, for which preparations are being made with great energy. A site has been selected, and 1,500,000 francs has been voted by the department, city and chamber of commerce. The various French colonies have already appropriated 5,000,000 francs to meet their expenses in this exposition, and further financial aid is expected.

Professor Boyce, F.R.S., Dr. Arthur Evans and Dr. H. T. Clarke, who comprise the 13th expedition despatched by the Liverpool School of Tropical Medicine to West Africa for purposes of scientific research, sailed from the Mersey, on December 14. We learn from the London *Times* that on the day before they were entertained to a farewell luncheon by Sir Alfred L. Jones, and a numerous company of Liverpool commercial men were invited to meet them. Sir Alfred Jones in proposing 'Success to the Expedition,' said the Liverpool School had accomplished invaluable work in the direction of making the West Coast more healthful and habitable to white men and natives alike. Mr. James Boyle (American Consul) pointed out that Liverpool was rapidly forging to the front as a scientific center, and both London and Edinburgh would soon have to look to their laurels. Mr. Walter Long, M.P., said that Liverpool and the nation at large owed an incalculable debt to Professor Boyce. In the history of British colonization and territorial acquisition the most painful page was that in which one read of the death, not of men who had fallen sword in hand fighting under the flag of their country, but of those countless thousands whose lives had been sacrificed, as they now believed quite unnecessarily, to a deadly and unseen enemy, which had wrought such terrible ravages in the past, and which they had every reason to believe could now be vanquished. This was a great work, and must result in conquests as great and lasting as any that science had yet achieved. Professor Boyce, in responding, said that the feasibility of Ross's views on this subject had now been proved up to the hilt.

UNIVERSITY AND EDUCATIONAL NEWS.

By the will of the late E. W. Codman of Boston and Nahant, Mass., an estate which it is said, may reach $1,000,000 will be equally divided between Harvard University and the Massachusetts General Hospital.

It is said that the classes graduating from Princeton University from 1881 to 1902 have each pledged $10,000 for the erection of a new dormitory.

The board of trustees of the University of North Carolina has authorized the organization of a School of Applied Science, consisting of the departments of mathematics and engineering, physics and electrical engineering, chemistry, geology and mining. Professor Gore is dean.

Dr. H. Meidinger, professor of applied physics at the technical institute at Karlsruhe, has retired from active service at the age of seventy-three years.

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SCIENCE

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FRIDAY, JANUARY 20, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*A TENTATIVE THEORY OF THERMO-ELECTRIC ACTION.**

LET the lines (1)–(1) and (2)–(2) in Fig. 1 be the lines representative respectively, of two metals M_1 and M_2 in the ordinary thermo-electric diagram. We may, if we please, think of these metals as copper and iron, respectively. The lowest horizontal line is the temperature coordinate and begins at the absolute zero.

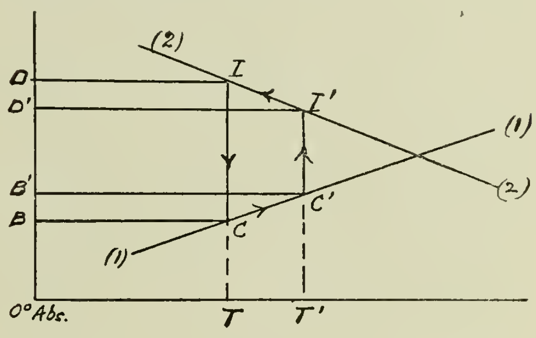

FIG. 1.

The diagram is so constructed that the area $CC'I'IC$ is equal to the net thermo-electromotive force, E, counterclockwise, in the circuit indicated by Fig. 2, in which the left-hand junction is kept at temperature T and the right-hand junction at temperature T'. We will suppose that E is expressed in mechanical units, as the

* Address of the vice-president and chairman of Section B—Physics, American Association for the Advancement of Science, Philadelphia, December, 1904. [The theory here given is certainly incomplete, and I fear that it is not entirely self-consistent. It is intended to be suggestive rather than conclusive or exhaustive.—E. H. H.]

amount of work done, at the expense of heat, on unit quantity of electricity while it goes once around the circuit. Evidently, then, the area $CC'I'IC$, which rep-

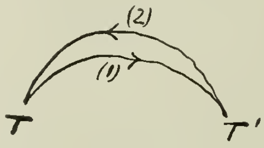

FIG. 2.

resents E, represents also the mechanical equivalent of the net amount of heat consumed by unit quantity of electricity in one cycle.

The arrow-points in Fig. 1 indicate merely the direction of the current resulting from the net E of the circuit.

It is consistent with what precedes to consider the area $BCC'B'B$ as representing that part of the total, or net, E which lies in the unequally heated M_1 between T and T', the area $B'C'I'D'B'$, as representing that part of E which lies in the junction M_1-M_2 at T', etc.; and this interpretation is sometimes given as a mere statement of fact. In the course of this paper it will, I hope, be shown that another view of the matter is consistent with the known facts of the case.

As this declaration puts me for the moment into a somewhat heretical attitude, let me hasten to say that I hold as strongly as any one to the proposition that the area $BCC'B'B$ represents the amount of heat absorbed by unit quantity of electricity in going through the metal M_1 from the temperature T to the temperature T', that the area $B'C'I'D'B'$ represents the heat absorbed by unit quantity of electricity in going from M_1 to M_2 at temperature T', etc. This proposition is familiar and needs no proof from me; but I wish to develop a little one aspect of it which is sometimes overlooked, an aspect which has a decided pedagogic value and which is at least suggestive of the line of thought I wish to follow later.

As we have in Fig. 1 a diagram in which areas represent heat absorbed, and in which one of the coordinate axes represents temperature, the other axis must represent entropy. Let us, therefore, in order to conform to the common practise in the use of the temperature-entropy diagram, make the T axis vertical, and the entropy, or S, axis horizontal, thus getting as the equivalent of Fig. 1 the Fig. 3.

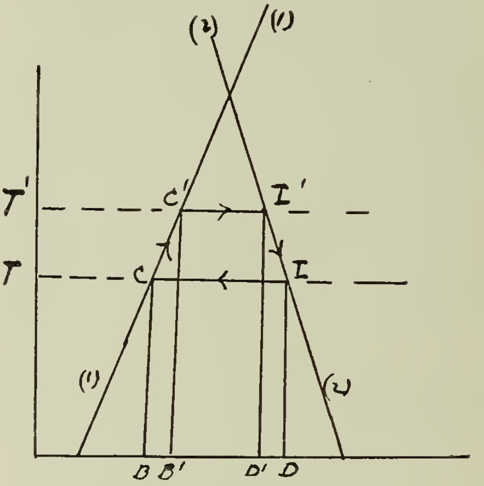

FIG. 3.

It is to be observed that Fig. 3 is the obverse of Fig. 1 so that the arrow points, without any relative change of position in going from one figure to the other, now lead clockwise around the area $CC'I'IC$.

Any one who is familiar with the temperature-entropy diagram of the steam-boiler-engine cycle, as given and discussed by Ewing, will see at once interesting points of resemblance between Fig. 3 and that diagram. For example, the sloping line CC', which indicates one phase of the Thomson effect, the absorption of heat by the electric current in passing through the metal M_1 from a point at temperature T to a point at the highest temperature, T', is analogous to the sloping line which in the steam-boiler-engine diagram indicates the absorption of heat by the feed water from the condenser in mixing with the hot water in the boiler. The slope of each line implies that the working agent, electricity in one case and water in the other, takes in the particular quantity of heat represented by the area under the line at a temperature below the highest of the cycle, and therefore, does not make the best possible thermodynamic use of the heat supplied and of the range of temperature available. Similarly the inclined line $I'I$, which indicates that heat is absorbed by the electric current in passing through the metal M_2, from temperature T' to the lower temperature T, is analogous to the line of the steam cycle which indicates the recovery of heat from the cylinder wall during expansion after cut-off.

Furthermore, the horizontal lines $C'I'$ and IC, indicating the absorption or emission of heat by the electric current in passing, without change of temperature, from one metal to the other, are analogous to those horizontal lines of the steam cycle which indicate absorption or emission of heat in the act of evaporation or of condensation. To this analogy we shall presently return.

Let us for the moment occupy ourselves with a reexamination of the prevailing opinion as to the relation between the heat absorption or emission at the junction of two metals and the difference of potential, or the electromotive force, at that junction, that is, between the thermal aspect and the electrical aspect of the Peltier effect. We shall find the situation not quite so clear as it is often supposed to be.

Maxwell* states that the amount of heat taken up or given out by unit quantity of electricity in going from one metal to another at any temperature is a measure of 'the electromotive contact force at the junction'; and he says that 'this application * * * of the dynamical theory of heat to the determination of a local electromotive force' is due to Sir Wm. Thomson.* He then goes on to declare that—"The electromotive force at the junction of two metals, as determined by this method, does not account for Volta's electromotive force. * * * The latter is in general far greater than that of this article, and is sometimes of opposite sign," etc.

* 'Electricity and Magnetism,' § 249.

* *Proc. Roy. Soc. Edin.*, Dec. 15, 1851; *Trans. Roy. Soc. Edin.*, 1854.

But it is a remarkable fact that Thomson, years after he had pointed out the method which Maxwell approves for determining contact electromotive force, came out (in 1862) with a letter giving a 'New Proof of Contact Electricity,' his famous 'divided ring' experiment, in which letter he says "For nearly two years I have felt quite sure that the proper explanation of voltaic action in the common voltaic arrangement is very nearly Volta's," etc.

I do not feel called upon to take up the cudgels for Thomson or for Volta. The point of immediate interest is that Thomson, after proposing the thermodynamic method of determining contact electromotive force, found it possible to hold a view contradictory to the soundness of this method. This fact may give the rest of us courage to question the finality even of Maxwell's opinion as to the relation between electromotive force and heat in the Peltier effect. I believe, too, that Poincaré, in article 292 of his 'Thermodynamique,' holds that the opinion supported by Maxwell may be wrong. Let us see what we can do with the question thus raised.

By *difference of potential*, $D_{2.1}$, between two points I shall mean the net amount of work which must be done because of the attractions and repulsions of electric charges (to use the convenient terms of action at a distance) in carrying unit quantity of positive electricity from point 1 to point 2.

By *electromotive force*, $E_{1.2}$, along a given path from the point 1 to the point 2, I shall mean

$$E_{1.2} = D_{2.1} + i_{1.2}R_{1.2},$$

where $i_{1.2}$ is the current from (1) to (2) and $R_{1.2}$ is the resistance of the chosen path from (1) to (2).

If either i or R is zero,

$$E_{1.2} = D_{2.1},$$

which is practically the case when we have a battery in open circuit, (1) being one terminal and (2) the other, or when we have under consideration two points on opposite sides of a junction of two metals, but exceedingly near together, even if a current is flowing from one to the other.

We have already, looking at Fig. 3, compared the passage of electricity from metal 1 to metal 2 to the evaporation of water in a boiler. Now in this evaporation work of two kinds is done upon the water, internal work and external work. The movement of electricity across a junction against a difference of potential corresponds to the external work of evaporation. Is there accompanying this movement anything corresponding to the internal work of evaporation? If so, the heat absorbed by the electricity in the movement may be as bad a measure for the difference of potential at the junction as the latent heat of evaporation would be for the external work of evaporation.

It is not absurd to imagine that there may be some change of state of electricity besides change of potential. It is possible that we should take account of something like an attraction between electricity and the metals with which it is associated. Helmholtz imagined such an attraction in order to explain the action of a galvanic cell. Indeed, we are familiar with the idea that attraction or repulsion exerted on the electric charge which ordinary matter may bear is communicated to the matter itself. When the charge on a pith ball is drawn this way or that, it carries the pith ball along with it. To be sure, this phenomenon and others like it may not indicate any fundamental attraction between ordinary matter and electricity. Perhaps they can all be explained by stresses in the dielectric surrounding or penetrating the ordinary matter; but whatever the true agencies may be, they at least simulate attraction or some physical tie between ordinary matter and electricity. We may, therefore, feel free to make speculative use of such attraction.

Our problem is to find, if we can, by use of any reasonable hypothesis, an explanation of the way in which heat drives an electric current around the circuit of dissimilar metals unequally heated.

There are two types of mechanical circuits or cycles operated by heat with which we are very familiar, the steam-boiler-engine cycle, in which the circulation may be practically in a horizontal plane, and various convection cycles, commonly used for heating and ventilation, which may be in vertical planes. In the horizontal cycle we must have valves. Circulation is secured by heating or cooling a fluid which is free to expand or to contract on one side, but not on the other side, the valves being so contrived as to give the necessary freedom and the necessary restriction. In the convection cycle we do not necessarily make use of valves. If the heating and cooling are effected at the right parts of the circuit, gravity supplies the differential force necessary to maintain circulation.

How can the metals of our thermo-electric circuit take the function of valves or the function of gravitation and so determine the flow of electricity at the expense of heat energy?

Let us consider first the case of a thermo-electric couple in which neither metal has any Thomson effect, but in which there is a tendency of positive electricity from (1) to (2) at each junction. The thermo-electric force of such a circuit can be accounted for by assuming that metal 2 attracts positive electricity more and negative electricity less than metal 1, and that both these differential attractions increase or decrease with change of temperature of the *electricity*.

At first glance one is likely to think that the differential forces here imagined must increase with rise of temperature, as it may at first seem that the forces at the hot junction must prevail over the opposing forces at the cold junction. But this need not be. The action must be such as to *take in heat at the hot junction* and to *give out heat at the cold junction;* but this condition is perfectly consistent with the prevailing of the attractive forces at the cold junction.

For, consider the analogous case of circulation of water in a pipe circuit made up of two verticals and two horizontals (see Fig. 5). If heat is applied at the proper part of one vertical and if heat is taken away from the proper part of the other vertical, the water will ascend against the force of gravity at the heated place and descend under the pull of gravity at the cooled place. That is, the attractive force, upon the differential action of which the circulation depends, prevails at the place where heat is taken out from the system.

Another analogous case is that of two galvanic cells of precisely the same kind, one cold and the other warm, set to work in opposition to each other. If the cells are such that each would grow warm (aside from the development of resistance heat within its parts) by its own direct action, the cooler cell will prevail, and *vice versa.*

So, if the spontaneous action at each junction of our two metals, if each junction could have its own way, would be such as to generate heat at the junction, the cooler junction will prevail when the two are opposed, and *vice versa.*

Now we have rather more reason for expecting, in a given untried case, that the free action of attractive forces will generate heat than we have for expecting that it will absorb heat. Consider, for example, the heat freed as the result of molecular attractions in the condensation of a vapor. Accordingly, if we are to account for a thermo-electric current, in such a combination of metals as we have imagined, by attraction of ordinary matter for electricity, this attraction varying with the temperature of the electricity, we are naturally led to the opinion that the colder junction prevails.

The assumption of such an attraction as we have here imagined, with its dependence on the temperature of the electricity and its independence of the temperature of the metal, except as the temperature of the metal determines that of the electricity within it, is much less violent than it at first appears. If there is such a phenomenon as the expansion of electricity, that is, a diminution of general volume density of electricity, with rise of temperature of the metal containing it, corresponding to the expansion of air or water in the heated part of a convection circuit, this is enough to give just the temperature relation required. For, the lessened volume density of the electricity at the hot junction of the two metals would imply a diminished tendency of the electricity to pass over to the more strongly attracting metal at that junction; but just as there is no tendency of water to flow by gravitation along an unequally heated pipe, if this pipe is horizontal, so there would be no tendency for electricity to flow along an unequally heated homogeneous metal bar, unless the hot parts of this bar attracted a given quantity of electricity more or less strongly than the cold parts. The two metals in which we have stipulated that there shall be no Thomson effect correspond in our thermo-electric circuit to the horizontal pipes of our imagined convection system; and for the comparison which we are here making it is well to go back to the usual disposition of the thermo-electric diagram, in which unequally heated metals having no Thomson effect are represented by horizontal lines.

Let us now consider a case in which the Thomson effect does play a part, such a case as that illustrated by Figs. 1 and 3. We can, apparently, account for the Thomson effect in any metal by assuming that this metal has a greater attraction for electricity of one sign than for electricity of the opposite sign, and that the difference of these attractions is a function of the temperature of the *metal*. With this condition the electricity of one sign at any part of a homogeneous but unequally heated metal bar will be subject to a net attraction, exerted by the metal, toward a place of higher temperature or toward one of lower temperature, according as the attraction between the metal and this kind of electricity increases or decreases with rise of temperature of the metal; and the other kind of electricity will be subject to a different, greater or less, net attraction from the metal; so that a difference of potential would be set up between the hot and cold part of the bar, if the bar were left to itself.

If we take the view that the electromotive forces which prevail are those at places where heat is given out, we shall in Fig. 3 have the local electromotive force, due to the attraction between metal and electricity, opposite at every place to the electromotive force commonly supposed to reside at that place; so that the unequally heated metals and the hot junction will still conspire against the cold junction; but, as the direction of the current is known by experiment to be that which is indicated by the arrow points in Fig. 3, we must in this case suppose that *the cold junction prevails over the opposing combination.*

Let us now consider the magnitude of the local electromotive forces. In any case the net electromotive force of the whole circuit is expressed, as we agreed at the beginning, by the area $CC'I'IC$ of Fig. 1 or Fig. 3. But knowledge of the net electromotive force of the circuit tells us little or nothing of the magnitude of the individual four electromotive forces of the circuit. Ordinary doctrine represents these by the areas, already mentioned, under the lines CC', $C'I'$, etc., in Fig. 3, down to the line of absolute zero of temperature, but as we now undertake to have the electromotive force at the cold junction prevail over the other three, it is evident that we must look for other areas on the thermo-electric diagram to represent these local forces. In this case we find such areas *above* the lines CC', $C'I'$, etc., in Fig. 3, or in Fig. 4, which we will now use in place

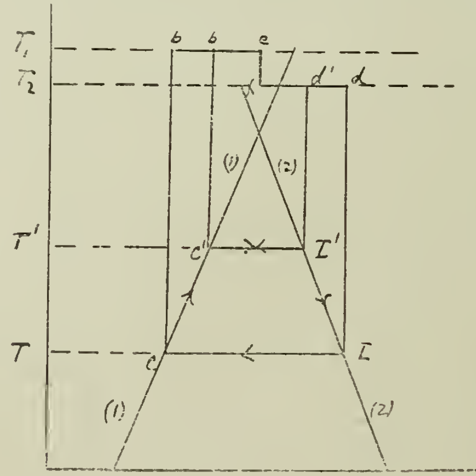

FIG. 4.

of Fig. 3. Thus the area $Cbb'C'C$, terminated above by the temperature line T_1, characteristic of metal 1, may represent the thermo-electromotive force directed from C' to C in the unequally heated (1).

Similarly the area $I'd'dII'$, terminated above by the temperature line T_2, characteristic of metal 2, may represent the thermo-electromotive force directed from I to I' in the unequally heated (2).* The area $C'b'efd'I'C'$, terminated above by the broken line $b'efd'$, depending on both T_1 and T_2, may represent the thermo-electromotive force directed from I' to C' at the hot junction. Finally the area $Cbb'efd'dIC$, terminated above the broken line $bb'efd'd$, depending on both T_1 and T_2, may represent the thermo-electromotive force directed from I to C at the cold junction. This last, larger than the sum of the others, which oppose it, would be the prevailing electromotive force. The net electromotive force of the circuit would be, as in Fig. 3, represented by the area $CC'I'IC$, and the current would run, as before, clockwise with respect to the boundary of this area.

We have apparently succeeded in accounting for the circulation of the electricity by means of differential attractions conditioned by differences of temperature and in showing that the local electromotive forces of the thermo-electric circuit may be opposite in direction to those which are commonly supposed to exist. But we have as yet given no conclusive reason why heat should go in at one part and out at the other, and we have not yet made any attempt to show how heat is used up in the circuit. Our explanation, so far as it has now gone, utilizes difference of temperature but does not utilize heat.

If we return to the consideration of our analogical convection system, we see that, if we were to put in heat at any point p only and take out heat at the point p' only, these two points being on the same level, there would be no continued circulation, as we should presently have the fluid at a uniform temperature all the way over from

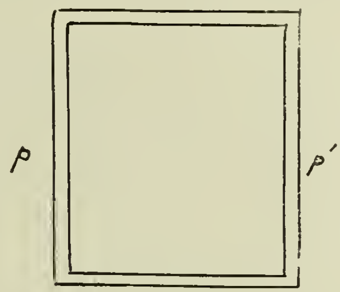

FIG. 5.

p to p' and at a uniform, though different, temperature all the way under from p' to p. To maintain circulation we must have the point p, at which heat enters, at a lower level, and therefore at a higher pressure, than the level and the pressure of the point p', at which heat comes out. The work and the absorption of heat at expansion under high pressure would be greater than the return work and the emission of heat at the lower pressure, and the difference between the inflow and the outflow of heat would be utilized in maintaining circulation against some resistance.

Do we naturally find anything in our thermo-electric circuit corresponding to this heat differential?

We have already assumed that the electricity within each metal acts like an expansible fluid, and it is natural to assume that the rise of temperature which causes the expansion of the electricity absorbs heat. That is, we naturally assume next that there is a real thermal capacity of

* T_1 is apparently the temperature at which the differential attraction of M_1 for the two kinds of electricity becomes zero. A like explanation holds for T_2. [The sloping lines might curve so as to strike the lines T_1 and T_2, respectively, at any angle.]

electricity, or of the corpuscles moving with it, which would come to the same thing. Moreover, we can hardly avoid supposing that the attraction which we have assumed to exist between metal and electricity holds the electricity within the metal in a state of pressure; and accordingly we must recognize in the thermal capacity of the electricity a part accomplished against this pressure in the expansion which accompanies rise of temperature.

Returning, with these additional ideas, to the examination of a thermo-electric circuit showing no Thomson effect, we find that we must in such a case suppose that in each metal the heat absorbed by the current of electricity, positive or negative, which is flowing from cold to warm within that metal is balanced by the heat given out by the current of opposite sign, negative or positive, which is flowing in equal strength from hot to cold within the same metal.

But at the junctions the case is different. At the junction which is the prevailing one, across which each kind of electricity flows from the metal by which its kind is attracted less to the metal by which its kind is attracted more, that is, from a place where the pressure caused by the attraction is less to a place where the pressure caused by attraction is more, each kind of electricity will, without change of temperature, suffer contraction of volume in the transition, and evolution of heat will result. On the other hand, at the other junction, where each kind of electricity moves, without change of temperature, from a place of high attractive pressure to a place of low attractive pressure, each kind will expand in the transit, and absorption of heat will accompany this expansion.

Thermodynamic considerations show us that in such a case as that which we are considering, in which there is no Thomson effect, heat must be taken in at the hot junction and heat must be given out at the cold junction. Hence our theory, with its later assumptions, assumptions suggested, as others have been, by reflection on the manner and reason of the working of an ordinary convection cycle, has led us clearly to the conclusion that the cold junction should be, in the case considered, the prevailing junction. But thermodynamic considerations go further. They require that the amount of heat, Q', taken in at the hot junction at temperature T', must bear to the heat, Q, given out at the cold junction at temperature T, such a relation that

$$\frac{Q'}{T'}=\frac{Q}{T}.$$

Can we without a straining extension of our assumptions meet this condition? Apparently we can do so by supposing that electricity in its state of compression within each metal obeys the law of a perfect gas. At the hot junction we have the positive electricity going, at constant temperature T', from the attractive pressure p to the attractive pressure $p-dp$, with consequent expansion, work of expansion, W', and absorption of heat equivalent to this amount of work. At the cold junction we have the positive electricity going, at constant temperature T, from the attractive pressure $p-dp$ to the attractive pressure p, with consequent compression, work of compression, W, and evolution of heat equivalent to this amount of work. From the gas law, $pv=KT$, we have, when T is constant,

$$pdv=-vdp=-\frac{KT}{p}dp.$$

This gives us, since p and dp are the same at the hot junction as at the cold junction,

$$W':W::pdv':pdv::T':T.$$

And so

$$Q':Q::T':T.$$

The production of absorption of heat within a single unequally heated metal, the calorimetric aspect of the Thomson effect, is, apparently, easily accounted for without additional assumptions. Thus, according to the theory already stated, the line CC' in Fig. 4 represents a case in which the attractive pressure of the positive electricity is greater at the cold end than at the warm end, while the attractive pressure of the negative electricity is greater at the warm end than at the cold end, of metal 1. According, positive electricity moving from the cold end to the warm end of this metal will expand more, and therefore absorb more heat, than the mere rise of temperature requires, while the negative electricity in moving from hot to cold within the same metal will contract less, and therefore give out less heat, than the mere fall of temperature requires. That is, to use the conventional mode of expression, the current absorbs heat where it flows from cold to hot in metal 1. For the line II' and the metal 2 the case is *vice versa.*

The conception of electricity, each kind of electricity, as acting within a metal like a perfect gas seems very revolutionary to one who has been strongly impressed by Maxwell's discussion of the analogy which the behavior of electricity in Faraday's 'ice-pail' experiment presents to the behavior of an 'incompressible fluid,' though Maxwell in pointing out this analogy warns us against being too much influenced by it.

The ice-pail experiment, however, as I understand it, proves merely the difficulty in putting an appreciable excess of either kind of electricity into a given space, a difficulty which still exists after all the assumptions of this paper are made. Consider, for example, the difficulty of putting any considerable excess of positive or of negative ions into an electrolyte. Indeed, the idea of the electric current within a solid as consisting of two oppositely moving perfect gases is so like the familiar and commonly accepted idea of the current in an electrolyte, where we apparently have two oppositely moving bodies of ions, each body obeying the gas law in its osmotic pressure, that, instead of being troubled by the heretical character of this view of the current in a solid, I am somewhat concerned lest I am failing to give due credit to some one who has already proposed it. Of course, Drude in his electron theory does apply the gas laws in some particulars to the electrons within metals, and I can not be sure that he has not anticipated me in much that is given in this paper, though I did not, so far as I am aware, get from him any of the main features of the theory here proposed.

The question naturally arises, Why not determine the direction and magnitude of the local electromotive forces of the thermoelectric circuit, and so get a decisive trial of the case between the ordinary and the proposed view of thermo-electric action? The reply is that physicists have been trying for more than a hundred years to get a satisfactory determination of a single one of these local forces, the one measured by the true contact difference of potential between any two metals, and have, apparently, not yet succeeded in the attempt. It is the old question of the Volta effect. Some months ago I was of the opinion that Mr. John Brown, F.R.S., of Belfast, had found a way of getting rid of the disturbing effect of the medium surrounding the two metals, zinc and copper in his case, by heating them for several hours in a certain kind of oil. Considerable recent experience with various kinds of oil at the Harvard Physical Laboratory has led me quite unwillingly to the conclusion that the kind of treatment to which Mr. Brown subjects his metal plates may substitute for the disturbing surface condition acquired in air an equally baffling surface condition produced by the action of the oil.

An attempt to measure directly the difference of potential between the two ends of an isolated unequally heated bar of metal would, apparently, encounter obstacles quite as great as those which have thus far proven unsurmountable in the case of attempts to measure directly the contact difference of potential between metals. The outlook is, therefore, not bright for any immediate and final answer, on experimental grounds, to this question of the direction and magnitude of the local electromotive forces with which we have been dealing.

I wish to add one afterthought. If electricity flows like a perfect gas through a homogeneous solid conductor of uniform cross-section, its velocity at any given cross-section of the conductor must be, approximately at least, proportional to the absolute temperature of this cross-section. Now the ordinary law of resistance in the case of a fluid moving through small passages is this: Resistance is proportional to the velocity. Accordingly, we are led to the conclusion that the resistance encountered by our electric stream should be proportional to its velocity, that is, other things being equal, proportional to the absolute temperature at the part of the conductor considered. Now we know that in pure metals this is the general law of resistance, and the fact that this law finds an explanation in a conception of the electric current formed without any reference to electrical resistance adds considerable weight to the argument in favor of that conception.

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THE ALAMOGORDO DESERT.*

The Alamogordo desert of southern New Mexico lies immediately west of the 106th meridian, west, and approximately between thirty-two and thirty-four, north. It is bounded on the north by the Oscuro range of mountains, on the east by the Sacramentos, on the south by the Jarillas and the Organ mountains, on the west by the San Andreas. As here defined, therefore, the desert is of comparatively limited area, one hundred or one hundred and twenty-five miles from north to south, and perhaps thirty-five to fifty from east to west; a very convenient little desert, easily manageable, one might suppose, for any naturalist, who, with inborn love of adventure, starts out in search of the wilderness to find scenes and pastures new.

A year ago in this presence, it may be recalled, the present speaker, by aid of photographic illustrations, attempted to sketch the relations obtaining, as would appear, between the geology of the desert and its flora; in the present paper it is intended briefly to resume the earlier argument with such added reflections as may be suggested by present conditions and by recent renewed acquaintance with the problem.

The desert of Alamogordo or Tularosa is a great plain, not unmarked, however, by singular topographic inequalities later on to be described. Only the most casual geologic examination is sufficient to show that the plain floor corresponds stratigraphically with the beds in some places exposed at or near the tops of the surrounding mountains, in any case far up their flanks. On the east especially limestones of carboniferous age rise sheer some 1,000 feet or more straight up from the desert floor, and are again capped by other strata only at length, perhaps 1,000 feet higher, surmounted by materials correspondent with those in the level of the plain.

On the west the same thing is true; but more emphasized still is the difference in

* Address by the vice-president and chairman of Section G for 1904. Philadelphia, Pa.

level between segments of corresponding strata. Here the weird Organ mountains break the horizon by upthrust spires and pinnacles of granite which to some early voyageur crossing these dusty plains suggested the pipes and architecture of some far-off organ, and the mountains were so named; but upturned granite means that the sedimentary rocks are here further uplifted still than on the eastern side, so that we quickly find ourselves in presence of vast parallel faults and our desert lies thus between their giant walls. It is as if half the region between this city and New York should suddenly sink two or three thousand feet, or what is the same thing, it is as if the several thousand feet of difference in level were brought about by the depression of the included area, and the simultaneous elevation of the sides. At any rate, the desert plain of the Alamogordo or Tularosa sands is simply the upper surface of a gigantic block of the earth's crust that sank some time subsequent to the deposition of the Jura-Trias and the earlier cretaceous strata of this western world. These strata include, as we know, the famous 'red beds' which tinge the mountains of half the continent, the red beds with all their gypsums, marls and salts of every description. Accordingly, as a result of this faulting, our desert has for its foundation everywhere great fields of gypsum, often for long distances wide-exposed, sometimes thinly veiled by loosened sand, sometimes deep buried by vast deposits of wine-red marls and clays, or covered anon by the products of erosion, whether by water or by wind. The waters from the mountain snows have brought their débris; the winds of the desert have come with their burden, but nowhere has such transportation traversed the desert borders, at least in recent times; there are to-day no excurrent nor percurrent streams; the winds die along the mountain walls and the waters sink in the desiccated sands.

But this is not all. This great sunken block of earth's crust seems itself to have been cracked again and again; there are secondary faults, and along the line of one of these thinner or weaker places the subterranean energies of the world have some time found emergence. Floods of lava welled up in the midst of the desert, and fountains of fire streamed along the ground, following existent topography for miles and miles, now narrowing to dimensions measured by rods between low ranges of hills, now widening for miles across the broader valleys, only to lie at last a vast field of blackened cinder, slowly disintegrated by the desert storms. This is one of the most peculiar topographic features of the whole desert. As things terrestrial go, this is a recent phenomenon. The age of the lava may be measured by centuries, a few thousand years, it would seem, at most. The surface over which it poured was a friable, marly soil. As the floods cooled, the mass cracked and gaped in every direction. Rains descending upon the surface sank to the ground below and shaped for themselves channels. The lava so undermined has fallen into a tumbled ruin of weirdness and confusion, indescribable, impassable.

The lava constitutes one of the features of this remarkable desert; there is yet another. Along the western border, partly uncovered by erosion, partly by the western winds, great bodies of gypsum lie exposed. As this slowly disintegrates the wind gathers the particles set free and bears them eastward, the famous white sands, covering township after township with drifted mineral white as snow. Vast windrows shifting slowly with every storm, and forever reinforced by the unceasing contributions of the west, mark the landscape over several hundred square miles, unique, intact, forever changing, yet the same forever.

Added to these peculiar and special topographic details of this surprising desert we have, of course, those less noteworthy, the common every-day features of desert make-up: we have mountain slope, rocky fields and hillsides, eroded valleys, marshy sinks, where lose themselves the vanishing torrential streams; wide plains of marly clay, belts of sand-dunes, red sands, yellow sands, also shifting and moving, but, better subservient to the vegetation of the region, these present simply vast fields of low hills or hummocks ten to twenty feet in height, separated on every side by tortuous valleys, winding in labyrinthine fashion, wind-swept, hard and bare.

One other topographic feature must yet be added to complete our picture. The forces of erosion even along the mountain walls have kept pace fairly well, at least, with the changes in level. Great cañons break back even through the hard, encrinitic limestones, dividing again and again where the waters have carved the rugged pathway by which the explorer may reach the mountain summit. The result of this erosion forms a wide talus around the desert, spreading great fan-shaped deposits at the mouth of the cañon, where immense blocks and boulders choke the exit, succeeded by ever smaller rocks and pebbles farther out, until at length only the finest silt is swept along from the widened margin far across the almost perfectly level plain.

Now it is evidently needless to say to every wisest man in an ecologically minded audience such as this, that every one of these peculiar topographic features, whether special or not, will display its own peculiar flora. True, this is not always the case; this desert must be studied in its entirety, and it will require months of patient research to even sketch its far-reaching problems. As a whole the flora may be said to be that of our western arid regions generally, and yet, after all, it is not just like that of any other region, north, south, east or west; not that it has peculiar species, perhaps, but that it has its own particular groups of species.

Two factors, and two alone, as it seems to me, determine the phytology of this desert; the one, difference in the constitution of the soil, referable to its geologic history; the other difference in level, referable to the same initiative. Thus there is a peculiar flora on the sands whether white or red; another on the silted plains less liable to transportation by the wind; another where the salts emerge, whether in briny springs and fountains or as crystals whitening the surface of the ground; another for the mountain shelves; and still another for their far-off summits.

The El Paso Northeastern Railway passes the desert on its eastern side. There are two stations on the line where for several miles in every direction the surface is a red-brown sand. One of these stations has been by the railroad people appropriately named Desert, the other is Escondida. The level of the two stations is the same, 4,000 feet, and the flora is identical, although the points are thirty miles apart. Each, however, is by itself unique and entirely separate from the other. The dominant species is *Yucca radiosa*, so much so that these points are called the yucca desert. Of course, the almost ubiquitous mesquite is there and *Atriplex canescens* and *Artemisia* —— *sp.?* There are other species, to be sure, such as forms of *Chrysothamnus* and *Ephedra*, but the plants first named give to the plain its character as far as vegetation goes, and in topography as well; they not only thrive here and come to abundant flower and fruit, but they hold these peculiar sands otherwise driven about the world by desert winds.

Now it is a remarkable fact that the white sands, thirty or forty miles off to the northeast, exhibit an almost identical flora. The student hastens across the intervening desert to meet that shining wall, expecting to find all things new; but, behold, the white sands are *sands* first of all rather than anything else. Whatever their chemistry, and they have their peculiar problem for the chemist, only a vegetation that can endure a moving, shifting terrene can flourish here. The white sands form, accordingly, part of the yucca desert. Their relation to vegetation is almost purely physical, but they exhibit some peculiarities. They are gypsum, as everybody knows,* but while they move as other sands, they must be compared with wet sands; the vast drifts, thirty to fifty feet in height, are *moist* often to within a few inches of the surface, and are so compactly driven that one may walk upon the solid surface with comparative ease. A white wall like to the appearance of marble is moving slowly eastward, whelming all vegetation as it goes, some of which, able to grow through the encroaching mass, persists, so that all the plants now appearing on the surface, so far as examined, are anchored by lengthened stems or roots to the underlying older soil. The same yucca that appears at Escondida here emerges sometimes by green tips from a snow-white drift twenty feet in height, or anon, seems to crown triumphantly some lower mound. The mesquite holds on, in some places a desperate fight, and certain species of *Rhus*—*R. aromatica* and *R. trilobata*, perhaps—maintain a perilous existence out over the whole region, sometimes even on the summits of the highest knolls. These sumacs are the characteristic species of the white sands.

But let us turn north. A journey of fifteen or twenty miles brings us to the black wall of the lava flow. This is a fearful region. The Mexicans call it *mal pais*, 'bad country'; giant floods whose waves are stone, fields and fissures, caverns, holes, pits and wells, alternating with tilted slopes, knife-edge culms and ridges, make a topography weird, impassable, fascinating because so unapproachable. Yet the *mal pais* is covered with vegetation. Of course, the vegetation changes, but by no means as one might easily suppose. Here is no new species, no variety of a species when the desert is studied as a whole. The change is correspondent to a change in level. The lava beds are high, and they are crowned with the flora of their own altitude. We shall meet it on the foothills of all the mountains we presently ascend. Here is no alteration of soil, for the only soil is that deposited by the wind, the lava itself being perfectly intractable. Here are the familiar mountain cedar, *Juniperus occidentalis; cholla*, sometimes twelve or fifteen feet high, where, springing in some ragged well-hole, it seems to peer out above the sooty walls that hem it in; here is the mountain barberry. Even the nut pine, *Pinus edulis*, has mistaken these pitchy steeps for the clayey flanks of its usual mountain fastness, and now and then rivals the cedar in its hold upon the jagged upturned edges of these flinty sheets. Even the lava beds have not apparently affected the general character of the desert flora.

At the south end of these black fields, however, emerge great springs. Here all the plain is saturated with salt and alkali, and here is a peculiar flora conditioned by this fact. The waters emerge almost from the edge of the lava sheets, and tufts of

* The following analysis of this material has been kindly furnished me by Dr. L. W. Andrews of the Mallinckrodt Chemical Works, St. Louis:

Calcium sulphate, $CaSO_4$	77.64	per cent.
Water, H_2O	20.55	"
Calcium carbonate, $CaCO_3$	0.95	"
Silica and undetermined, SiO_2, etc.	0.86	"
	100.00	

Suæda and *Allenrolfia* are set close against the lava wall. This is ideal; this we should expect and here it is.

The sands and the lava lie in the middle of our desert. If we take these as a starting-point and move toward the summit of the mountains, the successive belts of vegetation gradually shape themselves so that we learn presently to identify them by their color. A plain below the general level is gray, grass-covered, with here and there a bunch of *Ephedra* or nopal, no yuccas, no *Atriplex,* no other forms of cactus. As the terrene rises to the silt plain, thickets of cholla alternate with mesquite and the crucifixion thorn; not that other species do not occur, but these are dominant, give to the belt its character and color. A little further mountainward and we reach the *Covillea tridentata,* ever in bloom, which lies as a girdle of green and gold around the whole base of the mountain range, visible for miles and marking for us the limits of the talus with an exactness that is remarkable. Beyond the *Covillea* belt come the cacti as the terrene becomes more rocky; *Mamillaria,* with its species numerous and varied, the unique but widely distributed ocatillo, the prickly pear, often in giant form—all these cover the rocky slopes that lead up to the steeper walls of paleozoic rocks. Sometimes, where a shelf occurs, and the bare limestone forms a flat, mesa-like field, the yuccas come back, but not the Escondida form, with *Agave parryi,* and abundant ocatillo, while in the rocky defile below, locked amid gigantic boulders, now on their tardy journey to the talus plain, the creamy flowers and fruit of *Dasylirion* lift their glorious spikes, the envy and vexation of the photographer.

The strata of the lower carboniferous limestones now confront us; crystalline, encrinitic and exceedingly hard, rising often hundreds of feet sheer up and down. But these dry walls likewise have their flora. *Mamillaria micromeris* matches with its hoary spheres the weathered stone or lights it up betimes with scarlet bloom, and *Notholæna innata* fills with somber tufts every shattered crevice.

But the upper members of the carboniferous are much softer and, amenable to erosion, present a gentler, flowing topography. These slopes are everywhere clothed with oak, not trees indeed; far from it; low dense shrubs, the so-called shin-oak, *Quercus gambellii* and *Quercus gunnisoni.* These two species form pale green belts around the mountains, and are recognized easily, distinguishable for miles. These species indeed form a sort of phytographic border land; all below is desert; all above is forest; for above stands, or lately stood, one of the fairest bits of woodland in the United States, and that means in the world. But this forest is again in large measure conformable to geologic structure, its distribution determined by the history of what lies beneath.

As we ascend the mountain, passing all the carboniferous limestones, sands, chalk-beds and shales, we presently encounter the 'red beds' already mentioned, the most remarkable geological horizon in the country, familiar to every student of our central mountains, noted even by the ordinary tourist, the same wherever found—in Utah, Colorado, the Black Hills of South Dakota, and here again in these far-off mountains of the Mexican border, the same vast gypsum-burdened deposits of clay and shale and sand. The red beds yield easily to erosion. The washings from their wasted flanks have tinged the desert far below, and reddened the walls of every rocky cañon on the way. Sloping terraces and flat-topped hills afford a soil rocky but not infertile, supporting once more its own peculiar vegetation. Here are still the shin-oaks, it is true, but all overshadowed by other nobler trees; here is *Berberis trifolio-*

lata, the Texan barberry; here is *Pinus edulis*, Engelmann's nut pine, and most characteristic and perfect of all, here stands *Juniperus pachyphlœum*, the mountain juniper, great forests of it, ancient trees betimes, all comparatively low, but with giant trunks six or eight feet in diameter; these time-defying cedars are the trees of the red beds. With the junipers, especially as we pass their upper limits and come out upon the calcareous cretaceous swells and plains, occurs another oak or two. The soils are now remarkably rich in lime. The waters that fall on the higher mountain levels escape above the red-bed shales, but so impregnated with lime that they actually form a new stony deposit often for a distance of many rods about the point of exit. On these calcareous soils stands now the forest, along the very summit of the mountain, nine thousand feet above sea level, a magnificent forest of spruce and pine and fir: *Pseudotsuga douglasii*, the Douglas spruce, five or six feet in thickness; *Abies concolor; Pinus ponderosa* in beautiful perfection of its immortal youth; *Pinus flexilis* at its very best; a typical Oregon forest six or eight miles wide and some twenty long, crowning the summit of this isolated mountain peak in the midst of the deserts of southern New Mexico, for, as everybody knows, these are in general species of the forest of the far Pacific coast. As one stands now at last thus at the very summit of his problem, and from some promontory rock of vantage looks out upon the vast plain thus mountain-girt, the indescribable beauty of the scene must first impress him. Far to the west lie the San Andreas, the Organ and the Oscuro ranges, a long low wall, gray and solid, its serrate summits indentured in the azure sky; below, the plain, brilliantly lighted, soft and brown and lucid, save as the *mal pais* stretches its blackness as a bar sinister across the northern end, while away to the south the gypsum desert seems a cloud of snow beneath our feet, more brilliant than that evanescent whiteness that floats in the deep blue far above—the one the strange counterpart of the other; all is so silent, so changeless and so fair!

But just now we heed not the beauty of the landscape; other thoughts come crowding upon the observer, all equally insistent and impressive. Evidence of enormous physical change thrusts itself upon our astonished attention; not the sunken desert itself alone, that great block already described, but the denuded and sundered mountain walls, the great cañons that stretch back for miles, cut down through even the solid limestones at the mountain base—a process vast and old. Once the cretaceous sea rolled here, and when it retreated here were beds of limestones hundreds of feet thick. Where are they now? Only here and there a remnant on the mountain summit; the desert is covered with their débris almost to distant sea.

No less is one impressed by the slowness of all this topographic change. There is evidence of violence, suddenness, nowhere, save in the *mal pais*, which is local, recent, and does not affect the general problem. The moving currents of the air, the soft ministrations of the summer shower, the melting winter snows, have carved these mountains, are sculpturing them to-day. Those columnar whirlwinds that even now like dancing dervishes chase each other across the plain, are shaping anew the desert; that thin cloud that hangs yonder like a banner from the mountain top is a rainstorm, changing even now the general altitude of the range.

But once again; as we look out thus from the summit of our problem we are impressed with still another fact more far-reaching, more splendid still. The whole living covering of the world, the vegetative garment of the desert and the mountain, conforms exactly to the surface, to soil and level, no doubt with an exactness that we have only begun to guess or understand. There is a mathematical line that limits the distribution of every plant, but the area forever shifts and varies. The topography varies, except the *mal pais*, by changes so slight, so delicate, as to be imperceptible to eyes unskilled, and with the topography varies its covering of life. Let us say first that these topographic changes will change the limits of distribution. Once the sands cover the silt plains, and the grasses will vanish while yucca and artemisia succeed. Widen the talus and covillea will stretch farther its golden scepter. But the problem runs far deeper than this. As the face of the world undergoes these delicate, subtle changes, the plant responds in something far more than shifting distribution. A plant, as every student of botany well knows, is the most plastic sort of an organism in the world, responding in every sort of way to its environment. We who study the microscopic structure of the humblest plants understand the limitless possibilities here. When we reflect that the suppression of a single cell at the critical moment may change the direction of the axis or alter the contour of a leaf, it is hard to set too high an estimate upon the possible response made by a simple plant to environmental variations, however delicate. We who study the physiology of the plant, peer into its changing cells and strive in imagination to reproduce the marvelously intricate reactions, physical, chemical, that forever shift and play within those narrow limits—we need not be told that every vegetable cell has in it opportunities a thousandfold to match and meet all the subtle changes suggested by the slow-creeping but implacable forces that work out the physiognomy of this time-worn earth. A little more calcium here, a little more phosphorus there, sulphates, nitrates and the rest, and the thing is done. Nay, when we even think of the form in which all energy comes from yon distant sun, and the delicate machinery on which it plays, we need seek no further occasion for the intervention of every sort of outer cosmic force. Not a tree on all the Iowa prairies but shows in its every lineament, in its very expression, a response to the Iowa environment; and so, we may be sure, every desert plant records in its present form and stature all the affirmations, all the responses it has made in all the centuries to the bidding, the silent bidding, the most gentle coaxing, of the world external. For, note you, the call for change at any given instant has not been great; the slow upheaval of these mountains, their peaceful, gentle removal by the winds and rain; that is all; but that has changed and is changing the living world. Where the terrestrial call is rude or sudden, response there is none. The lava beds show no single characteristic species. Their flora is simply that of their own rocky level. Nor could here any sudden initiative on the part of the plant avail. The adaptation is absolute now, and to vary save as the environment varies would simply invite disaster. As well the tadpole suddenly assume lungs or the lizard put on feathers.

Nor is this all—our desert as it lies shining here before us is but a fraction of that wider, vaster desert that covers all the south and west. Across the Organ and San Andreas yonder is another desert exactly comparable to that we study; all Arizona, southern California, Sonora, Chihuahua, much the same; here and there a mountain summit tufted with forest, western in type, high slopes thinly clad with stunted juniper, benches of covillea, wide low plains covered with mesquite, with yucca and cactus and all the less noble plants that stand between; and our problem widens, becomes vast as the continent, and any answer that we make must be far-reaching as the flora of a world.

Our desert lies shining here before us; but not one of these plants except the cactus is in broader sense unique; each has its kin rising in happier fields to fairer fortune. The yuccas are lilies, but lilies bloom in Bermuda and in Teneriffe, and in every most fertile garden of the world. The mesquite is a *Prosopis*, but the *Prosopis* genus shows many a handsome forest tree, and even the mesquite in the Arizona valleys, where conditions are less hard, rises a forest with trees fifty feet in height. The cactus, as I read it, with undifferentiated floral leaves and abundant sporophylls, is an ancient adaptation to an ancient desert, possibly pre-cretaceous, and takes possession of the world just so fast as the world becomes desert; unstable in cultivation, not because new, but because reversionary.

I do not mean to say necessarily that the Alamogordo desert flora has had its origin where it stands, although such a contingency is not impossible of thought. Had this been the only desert on the continent its flora is as might have been expected. But there are a hundred similar intra-montane regions whose geologic history is the same. These have in similar fashion originally shaped a flora each for itself. No doubt once similar conditions are set up in regions at first unlike, an exchange of species may take place. American cacti are at home in the deserts of Europe and the Russian thistle flourishes on Dakota plains.

The desert lies shining here before us, changing forever, but all its changes are of imperceptible delicacy and slowness. Its methods would seem not different from those by which nature has from the first essayed the education of the vegetable world. Between salt water and fresh all conditions offer by infinitesimal shadings where the rivers meet the sea, thus green plants first emerged from ocean; all conditions from shore-line low-water mark to dry land, thus the plants at length sat on the shore, wet only by tides or by the gentle rain; all conditions of level by which the plants occupy the kingdom of the upper air: all conditions of spore-union by which they meet at length the problem of aerial fertilization: so that while sports there may be among plants outside the pale of cultivation, nevertheless, they must always be within limits set as result of more gentle changes effected by the slow, and for the most part exquisitely delicate, transformations which make up the history of the planet. Given a desert flora, a cactus flora, for instance, and there may be endless species-making, by sport, if you will, or otherwise, but in every case a cactus; but the cactus itself is the child of continental movements which brought about some old-time, perhaps cretaceous desert.

Our desert lies shining before us; it is old and silent: would you know its secret, read the rocky records that lie behind, around, beneath, and be assured that once the story of yesterday were understood, the facts of to-day would ask no wider explanation. The physical forces of this world still drive the loom that weaves the web of life. Before the loom the unseen weaver sits, guiding her web that passes to an endless roll, changing withal the width, the pattern, as conditions rise. Changes her arabesque, it is for cause, changes it not, it is alike for cause; and if at intervals, as we watch, anon new figures rise, may it not be but the return of some earlier triumphant cycle that here begins anew, evident enough in cause and feature were once that giant scroll unrolled, or were her watchers more patient, more enduring. Alas! in presence of this mighty loom what fleeting, evanescent interpreters are we!

Thomas H. Macbride.

FOURTH ANNUAL MEETING OF THE AMERICAN PHILOSOPHICAL ASSOCIATION.

The fourth meeting of the American Philosophical Association was held in Philadelphia, December 28–30, 1904, attended by about sixty members. In addition to the president's address, which was delivered on the evening of the twenty-ninth by Professor Ladd on the general subject, 'The Mission of Philosophy,' and which contained an able and eloquent plea for philosophy as a comprehensive and organized *Weltanschauung*, thirty papers were either actually read or read by title at the five sessions of the meeting. Two of the sessions were of special interest, that commemorative of the centenary of the death of Kant held on the afternoon of the first day of the meeting, and the joint session with the American Psychological Association held the following morning. At the Kant session, in which the newly formed Southern Society for Philosophy and Psychology was represented by its secretary, Professor E. F. Buchner, of the University of Alabama, who read a paper, based on a careful comparison of passages, on 'Kant's Attitude towards Idealism and Realism,' one naturally looked to see what estimate American philosophers now put on the work of the most influential philosophical thinker of the past century. Five papers were read dealing with as many aspects of Kant's philosophy. The general impression which they made on the mind of at least one hearer was that, in the opinion of the most careful students, Kant is neither to be ignored, nor belittled, nor 'outflanked,' nor, on the other hand, to be unduly exalted, but to be critically studied, and that he still counts, if not as the paramount, at least as one of the most potent influences in the philosophical thinking of our time. Perhaps the widest divergence from Kant's teaching appeared in Professor Royce's paper on 'Kant's Doctrine of the Basis of Mathematics.' Royce held that the certainty of mathematical science is rightly no longer regarded as depending on constitutionally predetermined forms of perception. And yet in another respect he held Kant to have been unquestionably right, so far, namely, as he declared that constructive synthesis and observation of its ideal results are both necessary for mathematics, an insight which has profoundly influenced the progress of mathematical science. The nearest approach to a eulogy of Kant was in Professor Caldwell's paper on the 'Present Significance of Kant's Ethics.' Professor Caldwell contended that Kant's teaching had been misunderstood, and in particular that it was not open to the charge of mere formalism commonly brought against it; that the significance of Kant's ethics lay in his spiritual philosophy of human nature, a philosophy implied in all recent attempts to treat moral judgment as one of valuation, in recent epistemological assumptions about personality and in the theory of sovereignty or autonomy in the ethics of social democracy; that his emphasis on the standard as the law of personal dealing in a social realm frees us from many of the difficulties in the teleological moral philosophy of the present; and that his version of the standard is the one most consonant with a true theory of moral progress. Professor Tufts read a paper on the 'Significant and the Non-Essential in Kant's Æsthetics,' a part of his philosophy which was held to contain, perhaps, as large elements of permanent value as anything he ever wrote, and Professor G. W. Knox gave an interesting address on the 'Influence of Kant on Theology,' calling attention especially to the affinities between Kant's negative criticism of the ontological argument and the primacy he assigned to the practical reason and the theology of the school of Ritschl. It is to be regretted that no more time was allowed for the discussion of these papers.

The first paper in the joint session with the Psychological Association, presided over by Professor W. James, was a criticism of Wundt's theory of feeling by Professor M. F. Washburn, of Vassar. The main point of the criticism was that the complexes of strain, excitement, etc., assumed by Wundt as feeling fusions really belong to an intermediate realm between sensation and feeling, and only ordinarily go unanalyzed because the organism has never needed to analyze them; but practical introspection reveals them as complexes of organic sensations. Two papers followed, one by Dr. D. S. Miller with the title, 'The Isolation of Minds,' the other by Professor Woodbridge on 'The Nature of Consciousness,' which had this in common, that consciousness, as distinct from what we are conscious of, was regarded as merely a relation of contents. But while in the one case this conception was elaborated to show that the co-experienced group of elements which constitute the contents of a consciousness at any moment had nothing in common with those belonging to any other consciousness, which latter, whether attributed to myself or another, were for the former only ejects, in the case of Professor Woodbridge it led to a suggestion of a realistic metaphysics hardly distinguishable from that which has commonly been called 'naïve.' Professor Ladd reported a case of nerve anastomosis in which the distal end of the facial nerve was united with the central end of the accessory nerve of the shoulder. By persistent efforts at voluntary control the subject was able at the end of about nine months to control the movements of the face without associated movements of the shoulder or contraction of other facial muscles. Analysis of the phenomena was held to contribute additional evidence discrediting both the idealistic and the psychophysical parallelistic theories of the relation of body and mind and confirming the theory of interaction. Professor Münsterberg gave an outline of the 'System of Values' which he is intending to elaborate in a book. The aim was to classify our absolute values and to see whether one principle controls the whole system. The values themselves were classified as validity, perfection, achievement and completeness, each relating to a particular sphere of experience and subdivided according as the value is given or created and refers to the outer world, to fellow-men or to self. The one category common to all these classes of value was found to be the category of identity. This paper, of which it is impossible to give here any but the barest suggestion, was generally felt to be the most important contribution to philosophy made at the meeting. It was so large in scope, implying, as it did, a whole system of philosophy, and so novel in matter that only the finished book itself can lead to a just appreciation of its significance, while it is certain that when the book does appear, it will provoke widespread interest and discussion.

Of the other sessions it is enough to speak briefly. At the opening session four papers were read of logical import, one by Dr. Marvin, limiting the field of epistemology to completely rationalized knowledge; one by the Rev. E. S. Steele, finding in judgment the unit of thought rather than in the idea, which was treated as only one of its elements; one by Dr. G. R. Montgomery, applying the mathematical notions of calculus to represent the mobility and functional interdependence of concepts, and one by Dr. W. H. Sheldon, defining the universal as a concrete fringe of the image or response suggesting further similar images or responses. In the afternoon session following the joint session, Professor Dearborn read a paper on 'Consciousness in the Brutes,' in which he held that the structure and metabolism of protoplasm in general, rather than that of the nervous system, was the physical basis of consciousness. Professor J. A. Leighton, in a paper in the 'Psychological Self and the Actual Personality,' contended that psychology, neither in its structural nor in its functional analysis does justice to the actual personality, which is manifested and realized in the constructions of historical culture. Dr. William T. Harris read a characteristic paper on 'Primary and Secondary Phases of Causality,' maintaining that natural science was founded on the latter and theology on the former. The other papers put down for this session were read by title, Professor Newbold's interpretation of a passage in Aristotle relating to mental synthesis being unfortunately crowded out for lack of time.

At the closing session on the morning of the thirtieth, Dr. Woodbridge Riley read an interesting chapter from a forthcoming book on deism in America, Professor F. S. Hoffman discussed the probability for immortality, Professor H. G. Lord discussed the nature and moral character of 'Gambling as Play.' This last was something of a surprise, for after seeking to determine the nature of gambling in general and of gambling as play in particular, Professor Lord, in the second part of his paper, which was a search for some solid basis for the moral judgment of gambling as play, arrived at the conclusion that there was no justification for its almost universal condemnation, a conclusion which no one present seriously disputed. Two other papers of merit on ethical subjects were read at this session, both by members from Cornell. Dr. H. W. Wright read on 'Ethical Method,' suggesting an evolutionary interpretation of morality, moral development being treated as a process of organization unified by purposive activity, the different virtues being regarded as necessary stages in the process. Dr. T. de Laguna read an admirably clear paper on the stages in the discussion of 'Evolutionary Ethics,' of which he distinguished five, partly contemporaneous: the first being concerned with a supposed conflict between ethics and evolution; the second setting up evolutionary laws as a standard for morality; the third treating ethical problems in terms derived from the theory of organic evolution; the fourth asserting the distinctive nature of social and of specifically moral evolution; and the fifth concerned with questions of method. The last paper read was by Dr. Percy Hughes, seeking an answer to the question, Is there a distinct logic of historical construction? The answer was affirmative; it was contended that a clear perception of action as the concept of historical construction would bring about important results.

At the business meeting of the association the following officers were elected:

President—John Dewey (Columbia).
Vice-President—J. A. Leighton (Hobart).
Secretary-Treasurer—J. G. Hibben (Princeton).
Members of the Executive Committee for two years—H. N. Gardiner (Smith) and R. B. Perry (Harvard).

It was voted to hold the next meeting, at the invitation of Professor Münsterberg and the members of the Harvard Philosophical Department, at Cambridge, in connection with the inauguration of the new Emerson Hall of Philosophy, and to invite to meet with the association the Western Philosophical Association and the Southern Society for Philosophy and Psychology. A vote of thanks was passed for the hospitality accorded to the association by the University of Pennsylvania. A vote was also passed in recognition of the services of the retiring secretary. Seven new members were elected. The association was well represented at the dinner of the naturalists and affiliated societies on the evening of the twenty-eighth, and the next night, following the president's address, an enjoyable smoker was held in conjunction with the Psychological Association.

H. N. GARDINER.

SCIENTIFIC BOOKS.

An Introduction to the Modern Theory of Equations. FLORIAN CAJORI. New York, The Macmillan Company. 1904. Pp. ix + 239. $1.75 net.

The present work falls into two nearly equal parts. The first 103 pages treat the following topics: Elementary properties and transformations of equations; location and approximation of the roots of numerical equations; solution of cubic, biquadratic, binomial and reciprocal equations; the linear and Tschirnhausian transformations. The remaining 120 pages are devoted to substitution groups and Galois's theory of the solution of algebraic equations.

The work has much that may be praised; in particular, its very moderate size, its choice of topics, copious references for further study, and a large number of illustrative examples and problems.

We mention now a few points which we believe might be improved in a later edition.

The definition of algebraic and transcendental functions in § 1 is not quite satisfactory. The author really defines *explicit* algebraic functions, and the reader might easily infer that all other functions were transcendental.

Would it not be well to give a mathematical definition of continuity of a function in § 25? The reader would then have a clearer idea of the import of the theorem of this section.

In § 26 the author assumes that a continuous function which has opposite signs in an interval must vanish in this interval. This requires demonstration unless an appeal to our intuition is allowed. If so, the demonstration the author gives, that every equation has at least one root, might well be replaced by a simpler one which rests on the property that a continuous function attains its extremes.

In § 65 the author makes use of continued fractions to prove the relation $mb - na = \pm 1$ where m, n are relative prime. It seems preferable, because more elementary, to prove this by means of the algorithm of the greatest common divisor.

In § 70 the assumption is made that numerator and denominator of a symmetric rational function are also symmetric. The definition of *incommensurable* in § 53 might be improved; we would also suggest the representation of complex numbers by points and not by vectors, as in § 22.

Let us turn now to the second half of the book which deals with Galois's theory. As the author tells us, he follows the exposition given by Weber. We must, however, in justice to Weber, note that the latter's treatment is not only more general, but is also free from a lack of precision of statement which mars the work under review and which is at times quite provoking.

The author restricts himself to equations whose coefficients are either constants or independent variables; why, we are unable to see. Certainly not because a greater simplicity is gained.

But this restriction once made, the reader should have clearly in view whether the coefficients of the equation dealt with in a given case are constant or variable. For results true when they are variable may be false when these coefficients are supposed constant. We regret to say the author is extremely careless in this important particular. Thus in chapter XI. we are informed in a footnote that the coefficients in this chapter are variables. In chapter XIII. we are left entirely in doubt; yet the theorems of Exs. 1, 2, § 119, which are used in a later chapter, may be incorrect if the coefficients are not independent variables.

This lack of explicitness is manifest in other parts of the book, *e. g.*, in the chapter on cyclic equations. The casual reader might well believe that the results established here are true for all cyclic equations. This, however, is not the intention of the author, for in one of the examples he informs the more careful reader that a large class of equations are excluded from consideration. This is, indeed, necessary, as otherwise the reasoning of § 172 may become illusory by the vanishing of $[\omega, a]$, as simple examples will show. But even with this restriction it must be shown or assumed that this expression does not vanish.

Another point which we believe has not been sufficiently emphasized relates to the equality or inequality of rational functions of the roots. How often in Galois's theory do we have to decide whether a rational function of the roots has or has not been *changed* or *altered* by a set of substitutions. The only explanation of this fundamental and delicate matter we have found is in a footnote on page 124.

Would it not be well to restrict the term *general equation* to one whose group is the symmetric group? The author follows well-established usage in calling a general equation one whose coefficients are independent variables. Because algebraicists thought a century ago that these equations represented the general case is no reason to perpetuate a term which is sure to produce confusion in the mind of the beginner. Apropos of these equations we must express our regret that the author has allowed the demonstration given in § 158 to pass muster; it is a demonstration which does not demonstrate.

James Pierpont.

Yale University.

La contagion mentale. Dr. A. Vigouroux et Dr. P. Juquelier. Paris, 1905. Pp. 250.

This is one of the volumes in the French *Bibliothèque internationale de psychologie expérimentale, normal et pathologique.* Mental contagion is the name here given to what is generally known as imitation in the narrow sense, *i. e.*, unconscious imitation. The process is unconscious on the part of both the imitator and the person imitated. Thus contagion excludes voluntary imitation and personal suggestion. The first half of the book deals with normal contagion and the second half with abnormal.

Assuming that the reflex arc is the fundamental type of neural action, and that the impulse may enter a given sensori-motor circuit from any sense and at any point in the circuit, we may trace a physiological explanation for all the contagious acts, *e. g.*, yawning, laughing, crying, coughing, dancing, marching, etc. Then, on the theory that every emotion tends to express itself in muscular adjustment, that this adjustment may be transmitted by contagion, and that a given emotional expression creates the emotion, the same explanation accounts for the contagion of emotional states *e. g.*, fear in a panic, anger in a revolution, the soldier's adoration of Napoleon, the schools of art and the havocs of intellectual bias. The same principle may also be extended to ideas because all ideas are more or less fused with feeling, *e. g.*, belief, scientific theory, dogma. The idea is contagious in proportion to the feeling present. Good analytic and genetic accounts run parallel to this mode of explanation, and special emphasis is laid on the social conditions and significance of mental contagion. The second part of the book consists largely of citation and classification of cases. The less normal the individual or the group, the more liable to contagion. Like the microbe, the mental contagion may be either beneficent or noxious.

A practical lesson from this book is preeminent: mental contagion is preventable. If insanity and crime are contagious, that principle should be recognized in our penal and corrective institutions; and society may take steps to prevent epidemics of fanaticism and crime. To-day science is interested in the physical microbes of disease; in the near future there will be a similar interest in the facts of mental contagion.

C. E. Seashore.

University of Iowa.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Journal of Science for January contains the following articles: 'Submarine Great Canyon of the Hudson River,' by J. W. Spencer; 'Radioactivity of Underground Air,' by H. M. Dadourian; 'Types of Limb-Structure in the Triassic Ichthyosauria,' by J. C. Merriam; 'Interaction of Hydrochloric Acid and Potassium Permanganate in the Presence of Ferric Chloride,' by J. Brown; 'Crystal Drawing,' by S. L. Penfield; '*Anemiopsis Californica* (Nutt.) H. ea A.: An Anatomical Study,' by T. Holm.

The December number of the *Journal of Nervous and Mental Diseases* opens with an article by Dr. J. Grinker on a case of juvenile tabes in a family of neuro-syphilitics, including careful investigations of the family history, and supplemented by a report of a rather unusual case of precocious tabes without evidence of syphilitic infection, with an exceptionally long course and with fragilitas ossium. Dr. Max Schlapp and Dr. J. J. Walsh unite in presenting a case of subcortical cyst and fibroma due to trauma producing Jacksonian epilepsy, cured by operation; and the original articles for the month close with a short paper by Dr. James Burnett on the therapeutic action of veronal. The proceedings of the Boston Society of Psychiatry and Neurology, May 19, 1904, are reported, and also the proceedings of the New York Neurological Society, May 4, 1904. The 'Periscope' gives abstracts of the *Journal of Mental Science, Nouvelle Iconographie de la Salpetriere, Journal de Neurologie,* and *Archives de Neurologie.* Books reviewed are: 'Unconscious Therapeutics,' by Dr. Alfred Schofield; 'Jahresbericht über die Leistungen und Fortschritte auf dem Gebiete der Neurologie und Psychiatrie,' by E. Flateau, E. Mendel and L. Jacobson, and 'Lehrbuch der speziellen Psychiatrie für Studierende und Aerzte,' by Dr. Alexander Pilcz.

The Popular Science Monthly for January contains the following articles: 'Some Experiments of Luther Burbank,' by David Starr Jordan, giving some of the results of his labors in producing new plants; 'The Present Problems of Paleontology,' by Henry Fairfield Osborn; 'Social and Political Effects of Immigration,' by Allan McLaughlin; 'Galileo,' by Edward S. Holden; 'Radio-activity and Matter,' by the late Clemens Winkler; 'Educational Problems,' by the Lord Bishop of Hereford; some interesting facts about 'The United States Pharmacopœia,' by H. C. Wood; and 'The Mosquito Investigation in New Jersey,' by John B. Smith, which shows the very important results secured during the last three years. There are very interesting brief articles in 'The Progress of Science.'

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES. ANNUAL MEETING, DECEMBER 19, 1904.

The academy convened for the annual meeting at 7:30 P.M., on December 19, at the Hotel Endicott. The president, Professor Edmund B. Wilson, occupied the chair. A formal session for the transaction of the regular business of the academy was first held, and this was followed by a dinner at which sixty-six members and their friends were present.

The accompanying reports of the corresponding secretary, recording secretary, treasurer, librarian and editor were read and placed on file. The report of the treasurer was formally referred to the finance committee for audit.

The academy then proceeded to the election of officers for the year 1905; Professors Hovey and Lloyd were appointed tellers, ballots prepared by the council according to the provisions of the by-laws were distributed, and the votes were counted. The following officers were declared elected:

President—James F. Kemp.

Vice-Presidents—Edmund O. Hovey (Section of Geology and Mineralogy), Ernest R. von Nardroff (Section of Astronomy, Physics and Chemistry), W. M. Wheeler (Section of Biology), F. J. E. Woodbridge (Section of Anthropology and Psychology).

Corresponding Secretary—Richard E. Dodge.

Recording Secretary—Hermon C. Bumpus.

Treasurer—Charles F. Cox.

Librarian—Ralph W. Tower.

Editor—Charles Lane Poor.

Councilors (to serve three years)—Emerson McMillin and F. H. Wiggin.

Finance Committee—John H. Hinton, C. A. Post, H. F. Osborn.

The following eminent men of science were elected honorary members, being presented to the academy for election by fellows engaged in scientific work similar to their own:

Hugo de Vries, professor of plant anatomy and physiology in the University of Amsterdam, The Netherlands. Presented by Professor Britton.

G. Johnstone Stoney, M.A., D.Sc., F.R.S., professor of natural philosophy in the late Queen's University, Dublin, Ireland. Presented by Professor R. E. Dodge.

W. C. Brögger, director of the mineralogical institute, Christiania, Norway. Presented by Professor Kemp.

Karl von der Steinen, professor of ethnology in the University of Berlin. Presented by Professor Boas.

Ferdinand Zirkel, professor of mining and geognosy in the University of Leipzig. Presented by Professor Stevenson.

Dr. Frederie A. Lueas was elected a fellow of the academy, being presented by the recording secretary.

Professor J. McKeen Cattell then proposed the health of Professor R. S. Woodward, a past-president of the academy, recently elected to the presideney of the Carnegie Institution.

The president of the academy, Professor Edmund B. Wilson, then delivered his address upon 'The Problem of Development,' at the close of which a vote of thanks was tendered to him.

The academy then adjourned.

Henry E. Crampton,
Recording Secretary.

Report of the Recording Secretary.

During the year 1904 the academy met in business session on eight occasions, and the several sections held thirty meetings, at which seventy-six stated papers and lectures were presented upon the following subjects:

	Papers.	Lectures.
Astronomy	2	1
Physics	11	
Chemistry	1	
Botany	5	
Paleontology	2	
Zoology	10	
Geology	6	
Mineralogy	2	
Physiography	2	2
Anthropology and Archeology	8	
Psychology	16	
Philosophy	6	1
Biography	1	

Particular mention must be made of the lecture upon the 'Physiography of the Alps' by Professor Albrecht Penck, an honorary member of the academy.

At present there are 278 active members, of whom 132 are fellows; the election of one fellow is pending. During the year two members have died, six have resigned, while six have been dropped on account of non-payment of dues. As five new members have been elected during the same period, there has been a net loss of nine.

In accordance with a recommendation offered by the library committee a more permanent union of the libraries of the academy and the American Museum of Natural History has been effected, to their mutual advantage. In regard to publications, it may be stated that the former method, according to which papers presented before the academy could be published in journals other than the *Annals* with the financial support of the academy has been set aside. In the future, as in earlier years, a volume of the *Annals,* to consist of three or four parts, will be issued during a calendar year.

Particular attention is now being given by the council to the matter of membership, and efforts are to be directed in the near future towards increasing the list of active members. As stated above, there has been a loss of nine during the year, although the members that resigned exceed the new members by one only. Maintenance, however, is not progressive development unless in the face of adverse conditions. The situation that confronts us is in some respects a difficult one, though not peculiar to the academy. The special societies, each dealing with some restricted branch of science, will tend more and more in the future, as they have in the past, to draw away active workers from general bodies such as the academy. Support for the academy may, therefore, be sought with a fairer prospect of success from those upon whom demands are not made by professional duties, that their activities shall be centered in the special organizations for scientific work. With such support, publieation as one of our two main objects may be furthered. Efforts should none the less be made to draw into the academy the younger men in active work, who must carry forward the activities of a scientific nature in the future, thus subserving the second purpose of the society.

One other subject of general interest must be mentioned. The council has decided that the routine work connected with the several offices of the academy shall be performed by a clerical assistant, with an office at the American Museum of Natural History, who shall be under the general supervision of the recording secretary. This arrangement provides for a still further centralization of the activities of the academy in the museum, where the library is already housed, and where the scientific meetings are now being held.

HENRY E. CRAMPTON,
Recording Secretary.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

THE ninth regular meeting of the Society for Experimental Biology and Medicine was held in Professor C. A. Herter's laboratory, at 819 Madison Avenue, New York, on Wednesday evening, December 21, 1904. Dr. S. J. Meltzer presided.

Members present.—Atkinson, Auer, Burton-Opitz, Dunham, Ewing, Flexner, Gies, Herter, Jackson, Lee, Levene, Levin, Lusk, Mandel, Meltzer, Murlin, Park, Richards, Salant, Wadsworth, Wallace, Wolf.

Members elected.—John Auer, F. G. Benedict, Ludwig Hektoen, G. C. Huber, H. S. Jennings, Jacques Loeb, Leo Loeb, A. B. MacCallum, J. H. Pratt, Torald Sollmann, J. C. Torrey.

*Scientific Program.**

Radium, and some methods for its therapeutic application, with demonstrations: HUGO LIEBER. [By invitation.]

Mr. Lieber gave an interesting account of the discovery of radium by Mme. and Professor Curie, and demonstrated many radioactive phenomena. Special attention was drawn to recently discovered facts bearing on radium emanation, which show that radium discharges primarily *emanations* and *alpha rays* only, but that the emanations soon disintegrate, with the resultant production of *beta* and *gamma* rays. Because of their nearly negative penetrative power, the alpha rays as well as the emanations are practically unavailable for therapeutic purposes when the radium is used in glass tubes or in similar containers.

Various observers have noted beneficial therapeutic effects of radium, especially on diseased tissues, as in cancer. Germicidal results have also been obtained. On the other hand numerous therapeutic failures have been recorded. The author believes that in all probability many of these disappointments have ensued solely because the practitioner has not had available, in such cases, just those radiations of radium which are required for therapeutic effects.

This opinion of past therapeutic failures led the author to conduct some experiments designed to discover a method of applying radium more advantageously. Such a method seemed to require (*a*) a disposition of the radium in *very thin layers*, so as to yield the maximum proportions of alpha rays and emanations, and (*b*) its application in a container *permeable by the rays and the emanations*. These experiments finally led to the production of what the author terms '*radium coatings*.'

The preparation of the coatings may be illustrated by their application to celluloid rods. The radium salt is dissolved in a solvent such as alcohol. The rod is then dipped into this solution. On its withdrawal, the radium solution adherent to the rod quickly evaporates, when the radium is deposited in a very thin layer. The celluloid is somewhat softened temporarily by the alcohol, a fact favoring superficial incorporation of the radium. Accidental removal of the radium may be effectually prevented by dipping the radium-coated rod into a proper collodion solution, quickly withdrawing it, and

* The abstracts presented in this account of the proceedings have been greatly condensed from abstracts given to the secretary by the authors themselves. The latter abstracts of the reports may be found in current issues of *American Medicine* and *Medical News*.

allowing the collodion to deposit in a thin film by evaporation. An anilin dye, when added to the radium and collodion solutions, shows the exact situation and extent of the coating.

The thin collodion covering is permeable to both the alpha rays and the emanations. Such coatings produce beautiful scintillations, on zinc sulfid screens. Very small areas, such as the tips of delicate rods, coated in the manner described, compare very favorably in discharging the electroscope, with 1 gram preparations of radium bromid of 10,000 activity *in glass tubes,* or with 10 milligram preparations of radium bromid of 1,000,000 activity in *thin aluminium tubes.* When air is blown over the radium coatings the air carrying the emanations discharges the electroscope. These facts were demonstrated by the author.

The radium coatings make it possible to apply radium directly to practically every part of the body. The radium thus applied would be practically equivalent in radioactive effects to the same amount of uncovered radium in a layer of equal thinness. Any instrument can be conveniently coated with radium at a desired place by the method indicated.

The author demonstrated a tubular apparatus, containing an inner radium coating and designed to convey radium radiations into the lungs, for experiments on the destruction of the tubercle bacillus. The same apparatus would be useful in other connections for direct treatment of diseased tissues. It was also shown that the radium coatings are not destroyed by sterilization. The activity of a strip of celluloid with a radium coating was undiminished after vigorous boiling.

The availability of the radium coatings for many kinds of biological investigation is so obvious that nothing need be said here regarding it.

Some of the physical phenomena of muscle fatigue, with demonstration of tracings. Frederic S. Lee.

The investigation of the subject has been continued by the employment of a method by which the isotonic curves of all the contractions of an excised non-curarized muscle stimulated at regular intervals, are superimposed upon a recording surface. The differences which were previously pointed out in the mode of fatigue of the muscles of the frog, the turtle and a mammal, have been confirmed. Lohmann's work, in which a frog's gastrocnemius on being heated to a mammalian temperature shows a course of fatigue similar to that of mammalian muscle, has been repeated and found in general correct. But the turtle's coracoradialis profundus, similarly heated, continues to give its characteristic curve of fatigue.

Kaiser's method for determining the point on the isotonic curve where the contractile stress terminates, has been employed for the frog's gastrocnemius, and it has been found that as the height of the curve diminishes in the course of fatigue, the contractile stress terminates at progressively lower and lower points. The lowering of the latter does not, however, seem to keep pace with the lowering of the summit of the curve. Hence the two points seem to approach one another.

A new form of float for water or alcohol manometers, with demonstration: Haven Emerson. [By invitation.]

The float consists of an aluminium cylinder with very thin wall, supporting a writing arm of fine aluminium wire. For manometer tubing of nine thirty-seconds inch inside diameter, three sixteenths or one fourth inch light aluminium tubing about two and one half inches long is used. In the upper end is forced a solid cap of aluminium, with a small hole in the center into which the wire for the writing lever is driven. The lower end is plugged with cork. A coating of paraffin prevents leaking. The value of the float consists in its cheapness, ease of construction, slight inertia and delicacy.

Gelatin as a substitute for proteid in the food. J. R. Murlin.

In a series of experiments on dogs, the nitrogen requirement of the body was determined by fasting periods. Varying amounts of gelatin containing from one fourth to two thirds of the required nitrogen were fed, the remainder of the nitrogen being supplied in meat proteid. The calorific requirement was estimated from Rubner's tables and was fully covered in each experiment with fats and carbohydrates. Results show an equal sparing of the body proteid with one fourth, one third and one half gelatin nitrogen, the coincident sparing of fats and carbohydrates being the same. When the coincident sparing of proteid by non-nitrogenous food is increased by feeding a larger percentage of carbohydrates and less fat, two thirds of the nitrogen requirement may be given in gelatin and perfect nitrogenous equilibrium maintained at the starvation level. The same result was obtained on man.

The reductions in the body in fever, with demonstrations: C. A. HERTER.

Dr. Herter demonstrated that elevation of the body temperature greatly accelerates the rate of reduction in the tissues. This was shown by means of an intravital infusion of methylene blue in a rabbit whose body temperature had been raised to 42° C. by the external application of heat. Simultaneously with this infusion another injection was made in a rabbit, of approximately equal weight, in which the temperature was maintained at about 39° C. Otherwise conditions in the two animals were practically the same. At the close of the infusions, the organs of the rabbit of normal temperature showed more color than those of the one in which the temperature had been elevated. The differences in the nervous system and the muscles were particularly striking.

The measurement of the reducing processes of cells in vitro, with demonstrations: C. A. HERTER.

An apparatus was demonstrated which had been devised for the purpose of measuring the reducing processes of the different kinds of cells *in vitro*. Definite quantities or organ pulp were placed in specially constructed tubes and anaerobic conditions were established by the passage of nitrous oxid gas. Definite quantities of methylene blue of known strength were then added. The rate of reduction was indicated by the disappearance of the blue color owing to the reduction of the animal cells. It was shown that *in vitro* the influence of temperature is the same as that observed in the living organism. The influence of alkali in accelerating reduction was also shown. The action of salts and various poisons is at present the subject of investigation.

Some medical applications of the naphthoquinon sodium mono-sulfonate reactions, with demonstrations: C. A. HERTER.

Dr. Herter demonstrated the reactions of this compound with anilin, various amins, nicotin, conin, piperidin, indol, skatol and pyrrol. Colored condensation products resulted. The reactions with indol, skatol and pyrrol possess unusual physiological and chemical interest and will form the subjects of future publications. The reaction with pyrrol, which is highly characteristic and should prove of special service to chemists, occurs in the cold and is evidenced by the deepening red which, on the addition of alkali, changes to purple, violet, blue and finally reddish brown. The addition of acid to the red solution obtained without alkali is followed by the development of a green and finally a brown color.

Among the biological and medical applications of these reactions, Dr. Herter mentioned the study of various aromatic compounds in the organism, the occurrence of certain intravital syntheses, the detection in the urine of organic compounds such as para amido phenol, and the development of a method of staining the bile capillaries by means of intravenous infusion of the derivatives of the naphthoquinon compound. Dr. Herter also stated that these substances facilitate the study of the relation between the chemical constitution and distribution of poisons in the body.

On the rate of absorption from intramuscular tissue, with demonstrations: S. J. MELTZER and JOHN AUER.

The authors tested a previous observation that absorption from the muscles is very much more rapid and efficient than from the subcutaneous tissue. Adrenalin, curare, morphin and fluorescin were used in the tests.

In the case of adrenalin, for example, it was found that when quantities of about 0.5 c.c. per kilo or even less were injected *intramuscularly* they at once caused (1) marked increase of blood pressure, (2) dilation of the pupil on the side from which the superior ganglion had been removed and (3) general prostration. When the same quantities of adrenalin were injected *subcutaneously* however, they were almost invariably without appreciable effect in any of these connections, or, when similar phenomena were produced, they were much less marked and their onset was greatly delayed.

Similar differences in absorption velocity and efficiency were shown in the cases of curare, morphin and fluorescin.

William J. Gies,
Secretary.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The regular fall meeting of the section was held on December 3, 11 A.M., in the office of the state chemist, Raleigh, N. C., with presiding officer, A. S. Wheeler, in the chair.

Preceding the presentation of papers a short business meeting was held and the following officers were elected for the ensuing year:

President—C. B. Williams, Raleigh, N. C.
Vice-president—J. E. Mills, Chapel Hill, N. C.
Secretary-treasurer—C. D. Harris, Raleigh, N. C.
Councilor—A. S. Wheeler, Chapel Hill, N. C.
Reporters—Chas. Walker, West Raleigh, N. C., and E. V. Howell, Chapel Hill, N. C.

The following papers were presented and discussed:

Some Problems in the Cellulose Field (presidential address). A. S. Wheeler, University of North Carolina, Chapel Hill, N. C. (Will be published by the section.)

The Action of Metals on Various Aqueous Solutions. G. McP. Smith, A. & M. College, Raleigh, N. C.

Molecular Attraction. J. E. Mills, University of North Carolina, Chapel Hill, N. C.

The article was a summary of work already published (*Journal of Physical Chemistry*, June, 1904) and of work along the same line yet to be published. An equation was deduced based upon the idea that the so-called cohesive forces between the molecules of a liquid could be entirely and quantitatively accounted for on the supposition of an attractive force between the molecules, the force varying inversely as the square of the distance apart of the molecules. The deduced equation was tested by an examination of twenty-five liquids over wide ranges of temperature and pressure. The measurements used, were, for the most part, those made by Drs. Ramsay and Young and Dr. Young. The result undoubtedly allows the conclusion to be drawn that the intramolecular forces obey a law exactly similar to the law of gravitation, *i. e.*, the attraction between the molecules of any liquid varies inversely as the square of the distance apart of the molecules, does not vary with the temperature and is a function of the number of molecules (mass) considered.

The results also point to the conclusion that the so-called molecular association, as in the case of water, is caused by this same molecular attraction and not by another force such as chemical affinity.

On Crompton's Equation for the Heat of Vaporization. J. E. Mills, University of North Carolina, Chapel Hill, N. C.

An equation proposed by Mr. Crompton (*Proc. Chem. Soc.*, Vol. 17, 1901),

$$L = 2RT \log_e d/D$$

(L is heat of vaporization, R is the constant of the gas equation, $PV = RT$, T is the absolute temperature, d and D are the densities of liquid and vapor respectively) was examined. It was shown that the latent heats so calculated were invariably and usually very considerably too high at low temperatures where the vapor pressure is small, but at high pressures as the critical temperature of the liquid is approached the results are in excellent agreement with the true heats of vaporization. Some important results following from this equation were pointed out. The article is to be published in the *Jour. Phys. Chem.*, December, 1904.

Some Notes on the Determination of Crude Fiber. J. M. PICKEL, Department of Agriculture, Raleigh, N. C.

A Method for the Extraction of Salicylic and Benzoic Acids and Saccharine in Food Products. W. M. ALLEN, Department of Agriculture, Raleigh, N. C.

On Biot's Formula for Vapor Pressure. J. E. MILLS, University of North Carolina, Chapel Hill, N. C.

It was shown that Biot's formula for the vapor pressure of a liquid,

$$\log P = A + bd^t + cB^t,$$

does not exactly represent the true vapor pressure of a liquid in the immediate neighborhood of the critical temperature. The article is not suitable for abstraction and will shortly be published in full.

Note on the Law of Dulong and Petit. J. E. MILLS. University of North Carolina, Chapel Hill, N. C.

Collected data for the specific heats of the metals were exhibited in the form of curves. The results show that the law of Dulong and Petit in its present form has but slight basis in fact.

On the Chemical Combination of Hydrogen and Oxygen when Subjected to the Action of Radium Radiations. CHARLES W. EDWARDS, Trinity College, Durham, N. C.

I desire to announce to the North Carolina Section of the American Chemical Society the discovery of the synthetic action of radium radiations in its chemical effects. Numerous effects have been observed and published wherein compounds have been decomposed into elements or transformed into simpler compounds. For instance, radium bromide dissolved in water produces H and O, it produces ozone in the air, and helium is produced by the radium emanation.

Certain investigations of a negative result carried out last year in England concerning the effect of ionization by ultra-violet light on gaseous mixtures led me to attempt the same problem, using radium as the ionizing agent. This I was able to do, thanks to the kindness of Dr. Bergen Davis and Dr. G. B. Pegram, of Columbia University, and of the department of physics in various ways, especially in the loan of five milligrams of pure radium bromide worth at present about $350.

The amount of chemical combination was measured by the change in volume of the gas exposed to the radiations. The saturation current was measured by the electrometer method and the following data are based on those measurements. I am now taking the current by a ballistic method and measuring volumes more accurately, so will soon have more accurate results. I will reserve the details for a later paper, but will state now a few results.

The quantity of gas converted to water was 18×10^{7} c.c. per second. In one cubic centimeter there are 4×10^{19} molecules, hence the number of molecules of gas that disappeared was

$$n = 4 \times 10^{19} \times 18 \times 10^{-7} = 7.2 \times 10^{3} \text{ per sec.}$$

three molecules of the mixed gases. If $M =$ number of molecules of water formed per second

$$M = \tfrac{2}{3} \times 7.2 \times 10^{13} = 4.8 \times 10^{13}.$$

If $N =$ number of physical ions produced, then in this case $N = 7.32 \times 10^{9}$.

Hence

$$\frac{M}{N} = \frac{4.8 \times 10^{13}}{7.32 \times 10^{9}} = 6.500.$$

From this it appears that 6,500 molecules of water were formed for each ion produced by the radium radiations—a result far in excess of expectations or theoretical predictions.

After the program the visiting chemists were the guests of the resident chemists at a table d'hôte dinner at Giersch's café.

C. D. HARRIS,
Secretary.

SCIENCE CLUB OF THE UNIVERSITY OF MISSISSIPPI.

THE first meeting of the Science Club of the University of Mississippi for the current session was held September 30, Professor J. W. Johnson presenting a paper on 'The Teaching of Physics.'

At the October meeting Professor R. W.

Jones led in a discussion of the subject, 'The Training of Chemists,' reviewing a recent paper by Sir William Ramsay.

Dr. P. W. Rowland followed with a statement of his views on the treatment of the opium habit. According to his theory something is manufactured in the fluids of the body of an opium eater which acts as an antitoxin—something positive is developed which counteracts or antagonizes the morphine. These opposing forces approximate a condition of equilibrium, thus enabling the victim to take ever-increasing doses. This partial equilibrium is lost when the morphine is withheld. It was considered possible to produce an antitoxin, and it was suggested that the club undertake an investigation to this end. Dr. Rowland thought that some lower animal, say the horse, could be rendered immune to poisonous doses of opium or morphia by repeated injections of the substance, and that the serum thus obtained would probably contain the antitoxin in the case of the habitué of morphine or opium.

The next meeting of the club was held December 2. Dr. J. B. Bullitt, the leader for the evening, after some introductory remarks on immunity to drug influences, addressed himself more particularly to the closely allied subject 'Immunity from Disease.' Attention was called to the fact that the lower animals are immune to certain diseases to which the human race is subject, and *vice versa*. It was also noted that some divisions of the race enjoy immunity where others show peculiar susceptibility. Natural and artificial immunity were discussed. The history of the various theories of immunity, with a brief statement of each, was given, and special emphasis was laid on the 'side-chain' theory.

Alfred Hume,
Secretary.

DISCUSSION AND CORRESPONDENCE.

AN EXAMPLE IN NOMENCLATURE.

Mr. David White has published in the 'Smithsonian Miscellaneous Collections' (Quarterly Issue), Vol. XLVII., Pt. III., pp. 322–331, pl. xlvii, xlviii, a paper on 'The Seeds of Aneimites.' He shows that he has specimens of the foliage of that genus with seeds attached, also an abundance of detached seeds. He names the species bearing these seeds *Aneimites fertilis* n. sp. But he says that he discovered the seeds before he could be certain that they belonged to *Aneimites*, and had contemplated giving them the name *Wardia*, that he had even gone so far as to give them that name in a manuscript in preparation, but that he had postponed publication 'in the hope that further study * * * would yield * * * evidence bearing either on the internal organization of the fruits or on the structure of the fronds.' Such evidence he subsequently found and established to his satisfaction that the 'fruits' belong to the genus *Aneimites*, a supposed fossil fern, thus adding one more to the rapidly growing list of Paleozoic seed plants.

On page 323, where the species is described, he calls it "*Aneimites* (*Wardia*) *fertilis* n. sp., but in other places *Aneimites fertilis*. He, however, constantly refers to the seeds as *Wardia*, and in at least one place (p. 329) he calls them *Wardia fertilis*. He does not pretend that they belong to a different genus from *Aneimites fertilis*, and, indeed, proves that they are the same, and the specific name is the same for both combinations. What he has done is to take a name from an unpublished manuscript of his own and publish it for the first time as an exact synonym of the name that he gives to the species. The name *Wardia fertilis* is, therefore, stillborn, or at least strangled at its birth, and has no validity whatever.

Now why should he thus cumber an overburdened literature with another worthless synonym? Such a proceeding in the present state of science is a recognized crime. As Mr. Bather said in discussing a similar case some time ago, what does the scientific world care for his private excogitations over material too imperfect for publication?

But the name *Wardia* was preoccupied anyhow, for that name was given by Harvey and Hooker in 1836 to a genus of mosses from the Cape of Good Hope,* dedicated to N. B. Ward, Esq. The genus and one species, *W. hygrometrica,* were fully described and figured. If it be said in extenuation that the work in which it occurs is somewhat difficult of access, this can not be said of Endlicher's 'Genera Plantarum,' which is in all libraries, and where (p. 1345) the genus is redescribed and is duly entered in the index. The author of this two-fold achievement is a member of the Committee on Botanical Nomenclature! LESTER F. WARD.

* 'Wardia: a New Genus of Mosses, discovered in Southern Africa,' by W. H. Harvey and W. J. Hooker; *Companion to the Botanical Magazine,* Vol. II., London, 1836, pp. 183–184, pl. xxv.

DELUC'S 'GEOLOGICAL LETTERS.'

TO THE EDITOR OF SCIENCE: With all due respect for the opinions of Dr. Emmons and Sir Archibald Geikie, I am unable to see why von Zittel was not scrupulously exact in his handling of facts when crediting Deluc with prior use of the term 'geology' as compared with de Saussure. The latter uses it but twice, defining it as 'la Théorie de la Terre,' in the earliest edition of his work, published in 1779. The second authorized edition of Deluc's 'Letters' (it had already been pirated) appeared also in 1779, the term 'geology' occurring in the body of the work an equal number of times (vol. I., pp. 4, 5), and again in a footnote on p. 7, where it is observed that the word 'cosmology' is more generally used in an equivalent sense.

It is worth noting that this footnote, which purports to be of identical† tenor with the first edition, scarcely justifies the assertion that Deluc 'could not venture to adopt the term geology because it was not a word in use.' More to the point is a passage where the author expressly designates the work in hand as a *treatise on geology:* 'Je vis que je faisois un Traité, et non une esquisse de Géologie.' He constantly refers to it later under the abbreviated title of 'Lettres Géologiques,'* and intitulated another of his productions 'Traité élémentaire Géologie.' It appears, therefore, that beginning with 1778, a year before de Saussure's work saw the light, and continuously thereafter, Deluc employed the term geology in its modern sense; hence he is entitled to generous consideration for having helped bring the name our science now bears into familiar use. Deluc, in pointing out the etymological propriety of 'geology' no doubt furnished a suggestion which de Saussure immediately caught at, since he twice employs the term, as Dr. Emmons has said, 'without any explanation or apology,' and alludes also to 'the geologist,' as is natural. Von Zittel seems to me to have exercised very candid judgment in this matter, and one must be a very 'strict constructionist' indeed who can deny Deluc's claims to priority.

Almost simultaneously with the authors just considered, the celebrated Werner appears to have been instrumental, to some extent, in popularizing the term geology. Werner's definition of this and cognate words is given by one of his distinguished pupils, d'Aubuisson, from whose 'Traité de Géognosie' we extract the following (vol. I., p. 2): "Werner remarque, en outre, que les noms composés de *logos,* tels que zoologie, minéralogie, etc., désignent l'universitalité de nos connaissances sur un objet; et, d'après cela, la géologie comprend, selon lui, non seulement la géognosie, mais encore la géographie, l'hydrographie, la géogenie, etc."

C. R. EASTMAN.

December 29, 1904.

† The text reads as follows in the 1779 edition: "Je répète ici, ce que j'avois dit dans ma première *Preface,* sur la substitution du mot *Cosmologie* à celui de *Géologie:* * * * c'est que l'usage ordinaire a consacré le premier de ces mots, dans le sens où je l'emploie."

* Compare, for instance, his frequent correspondence in the *Journal de Physique.*

UNIVERSITY REGISTRATION STATISTICS.

TO THE EDITOR OF SCIENCE: On reading the article 'University Registration Statistics' (SCIENCE, N. S., Vol. XX., No. 552, December 30, 1904), it occurred to me that it would be interesting to know the average number of students to each teacher, in the institutions mentioned. The 'Total Registration' (not including the 'Summer Sessions'), divided by the number of officers gives the results as shown in the last vertical column of the table appended. The figures in the second and third columns are transcribed from the article referred to above.

Institution.	No. of Students.	No. of Officers.	No. of Students to One Officer.
California	3,130	330	9.48
Chicago	2,218	184	12.54
Columbia	4,056	551	7.36
Cornell	3,364	451	7.45
Harvard	4,516	534	8.45
Illinois	3,233	365	8.85
Indiana	882	72	12.25
Johns Hopkins	740	156	4.74
Leland Stanford Jr.	1,420	130	10.92
Michigan	3,667	270	13.58
Minnesota	3.671	197	18.63
Missouri	1,536	88	17.45
Nebraska	2,414	173	13.95
Northwestern	2,806	346	8.10
Ohio State	1,723	143	12.04
Pennsylvania	2,940	330	8.90
Princeton	1,385	114	12.14
Syracuse	2,419	201	12.03
Virginia	691	45	15.35
Wisconsin	2,668	243	10.97
Yale	2,995	330	9.07

William B. Schober.

Lehigh University,
January 5, 1905.

SCHOOLS OF TECHNOLOGY AND THE UNIVERSITY.

To the Editor of Science: In connection with the proposed combination of the Massachusetts Institute of Technology with Harvard University, the following authoritative statement of foreign opinion (translated from *Zeitschrift des Vereines deutscher Ingenieure* of September 24, 1904) is of interest:

At a meeting of the Union of German Engineers, held at Munich September 12, with the participation of thirty eminent representatives of technological schools and universities, as well as of other schools and of industries, the following resolutions were adopted:

1. It is not advisable, so far as can be foreseen, to attempt to meet the need of new technological schools by the addition of technological faculties to universities, but rather by the establishment of independent institutions; for the technological schools would be hindered in their independent development by attaching them to universities. This separation should not, however, impede the welcome development of intellectual good will between the two institutions. The attachment to universities would also in no way involve economies of consequence.

2. The Union of German Engineers stands now, as before, by its expression of 1886, as follows: "We declare that the German engineers have the same needs and will be subjected to the same judgment as to their general culture as the representatives of other professions based on higher scientific education." In this view we rejoice as the conviction more and more gains ground that a considerably greater significance is to be attributed than before to mathematical and natural science as a means of culture. Knowledge of these branches is becoming more and more an indispensable constituent of general education. The predominantly linguistic education now received by the majority of our gymnasium graduates does not satisfy the demands which must be made on the leading classes of our people, in particular, in respect to the increasing significance of economic questions.

Tech Graduate.

SPECIAL ARTICLES.

PROPOSED INTERNATIONAL PHONETIC CONFERENCE TO ADOPT A UNIVERSAL ALPHABET.*

I wish to call your attention to a circular recently issued by Boston University, inviting opinions on the proposal to hold an international conference for the purpose of adopting a universal alphabet. In the Roman alphabet we already have a practically universal alphabet. A comparatively slight effort will suffice to make it perfect and quite universal. Whoever has looked into the subject knows that it is perfectly practicable to introduce such modifications in the Roman alphabet as to make it perfectly phonetic and yet leave the spelling in such condition that it shall be readily legible to people who know only the Roman alphabet in its present form.

I need not dilate on the advantages to be expected from the use of an alphabet which would enable every child to read as soon as it knew the letters, and which would, furthermore, enable any one to pronounce foreign languages correctly at a glance, because their spelling,

* Read before the Comparative Philology Section of the Language Group of the Congress of Arts and Science at St. Louis, September 21, 1904.

apart from a few special sounds, would be the same as in his own language. It is easy to see how this would promote pleasant intercourse and mutual understanding among the nations, by facilitating the acquisition of foreign languages. All the leading languages would thus tend to expand and to become cosmopolitan; but most of all would this be true of English, which is more hindered in its expansion by its spelling than any other language. It is, perhaps, not too much to say that the universal alphabet will confer on the English language the patent of universality.

To prepare such an alphabet is a comparatively easy task. The real problem is how to get it accepted by the public. Scores of such alphabets exist already, but not one of them possesses sufficient authority to compel its universal use. How shall such authority be secured?

To this question the circular recently issued by Boston University seeks to obtain an answer. It invites opinions on the plan to hold an international conference for the purpose of adopting a universal alphabet to be used first of all as a key to pronunciation in all dictionaries of the leading languages. I may state at once that the replies received from the editors and publishers of the great American dictionaries are highly encouraging. They state with practical unanimity that, if a universal alphabet were drawn up by a commission composed of the foremost experts, and invested with the requisite authority by scientific bodies of high standing, they would introduce that alphabet as a key to pronunciation in future editions of dictionaries, primers, readers, grammars and language manuals as fast as practicable.

It is evident that, if the dictionaries adopt this universal alphabet, a large part of the rising generation will become familiar with it. It will be used by everybody who wishes to indicate pronunciation. It is even probable that the entire rising generation will soon grow accustomed to it, for the following reasons: Experiment has proved that children beginning with a phonetic alphabet learn to read in a few weeks and master even the ordinary spelling more rapidly than by the present method. The reason is evident. The essential part of the art of reading consists in the ability to recognize the outline of a word at a glance, without having to spell out the letters. Having in a few weeks acquired the ability to recognize words in the phonetic spelling, children will recognize them also in the traditional spelling, because the difference in the outline will in most cases not be great. We see this daily illustrated by the ease with which school-bred immigrants learn to read English, though accustomed at home to a totally different spelling. Having acquired in their own language the ability to recognize whole words at a glance, they soon begin to recognize also English words whose meaning they have learned from conversation.

When the universal alphabet has been adopted in the dictionaries, it is certain that the experiment of beginning with it in the primary schools will be made in many parts of the country, for the movement has many friends among educators. When the results of these experiments become generally known, it will not be long before all the schools begin with the universal alphabet. For some time they will doubtless use it merely as an easier method to teach the traditional spelling; but when it is found that children, after two months of schooling, are able to read any book printed in the phonetic spelling, the question will soon be raised why they should be forced to spend another year or more in learning another spelling.

It will be noted that the acceptance of the universal alphabet by the dictionaries was made subject to an if. They are willing to use this alphabet if it is presented to them invested with a sufficient degree of authority. Nothing should be neglected that can add to this authority. Hence the commission which is to prepare the universal alphabet must fulfil four conditions:

1. It should be composed of the foremost experts in phonetics.

2. They should be invested with representative power by learned bodies of the highest standing.

3. They should receive their final commissions from the various governments.

4. They should conduct their work not merely by correspondence, but should have at least one meeting, preferably several meetings, occupying an adequate length of time.

The scholars able to do the work exist; it only remains to enable them to organize. For this purpose, the circular issued by Boston University is to serve as a preliminary step. Its aim is to obtain the opinion of the learned public. Thus far it has been sent only to the members of the Philological Association, and it may be stated that out of 67 replies received up to September 16, only 4 questioned the utility of the conference, the great majority being emphatic and even enthusiastic in its advocacy. In a few weeks the circular will be sent to every university professor in the United States and Canada.

The question has several times been asked, why a conference of the English-speaking nations alone would not suffice. The answer may be gathered from what has been said above. The supreme need of the phonetic alphabet, in order to secure its adoption by the public, is authority; and of course the authority of a universal alphabet, adopted by an international commission, would far exceed that of an alphabet devised for one language only. It is desirable to secure the use of the alphabet by the largest possible number of persons at once, in order to impart to it the requisite momentum to carry it into popular use. Evidently the momentum of an international alphabet will be incomparably greater than that of a merely national alphabet. Above all, it must be remembered that the sounds of the leading European languages are for the most part nearly identical, and that all the nations are striving to adopt phonetic alphabets. If now each nation does this for itself, we shall be confronted with the dilemma that either needless differences will be permanently established between the languages, or, if there is to be identity of writing to correspond with the practical identity of sounds, certain nations will be forced to abandon their laboriously constructed systems in order to conform to the system of another nation. The obvious remedy, the reasonable, neighborly, courteous method is an agreement by the common consent of all the nations concerned, and now is the time to secure it, while as yet none of the national phonetic alphabets have found any notable degree of acceptance.

The realization of the conference is simply a matter of expense. It means that a dozen or a score of the most eminent scholars shall be enabled to devote the requisite time to it. If the replies to the circular demonstrate that the great majority of the learned public favors the plan, it seems entirely probable, in view of the importance of the subject, that the requisite funds will be forthcoming.

Robert Stein.

U. S. Geological Survey,
Washington, D. C.

AWARDS TO THE COLLECTIVE EXHIBIT OF THE LAND-GRANT COLLEGES AND THE EXPERIMENT STATIONS.

The collective exhibit of the American colleges of agriculture and mechanic arts and the experiment stations at the St. Louis Exposition, illustrating special features of the instruction work of these institutions and the methods and results of the agricultural experiment stations, was awarded 27 grand prizes, 37 gold medals, 35 silver medals and 35 bronze medals, a total of 135 awards, aside from those made to individual exhibitors. The collective exhibit as a whole received a grand prize; and similar awards were made to the sections of agronomy, in charge of Mr. J. I. Schulte, of the office of experiment stations; of horticulture and forestry, in charge of Professor S. B. Green, of Minnesota; of economic entomology, in charge of Professor C. P. Gillette, of Colorado; of mining engineering, in charge of Professor S. B. Christy, of California; of architecture, in charge of Professor W. H. Lawrence, of Massachusetts; of mechanical engineering, in charge of Professor W. F. M. Goss, of Indiana; of drawing and shop practice, in charge of Professor F. P. Anderson, of Kentucky; and of technical chemistry, in charge of Dr. W. H. Walker, of Massachusetts; to the dairy laboratory, in charge of Professor E. H. Farrington, of Wisconsin; the sugar laboratory, in charge of Dr. W. C. Stubbs, of Louisiana; and the plant laboratory, in charge of Dr. W. H. Evans, of the office of experiment stations.

Gold medals were awarded to the sections of animal husbandry (2), in charge of Dr. H. P. Armsby, of Pennsylvania, and Professor Thomas F. Hunt, of New York; of fertilizers, in charge of Dr. E. B. Voorhees, of New Jersey; of plant pathology, in charge of Mr. F. C. Stewart, of New York; of rural engineering, in charge of Dr. Elwood Mead, of the office of experiment stations; and of veterinary medicine, in charge of Dr. D. S. White, of Ohio; and to the soils laboratory, in charge of Professor M. F. Miller, of Ohio.

Awards of silver medals were made to the section of biological sciences, in charge of Dr. G. E. Stone, of Massachusetts, and that illustrating the inspection work of the stations, in charge of Director M. A. Scovell, of Kentucky; and bronze medals to the sections of home economics, in charge of Miss Maude Gilchrist, of Michigan, and of rural economy, in charge of Professor F. W. Card, of Rhode Island.

Awards were also made to institutions represented in the exhibit as follows: Grand prizes to the Alabama, Connecticut State, Illinois, Louisiana, Minnesota, Missouri (2) New York State, Pennsylvania and Wisconsin experiment stations; to the agricultural colleges of Missouri and Wisconsin universities; to the College of Mining, University of California; to the bureau of education, and to the office of experiment stations, Department of Agriculture. Gold medals to the Arizona, California, Connecticut State, Connecticut Storrs, Maine, New Jersey, New York State (3), Tennessee, Washington and Wyoming (2) Experiment Stations; to the Colleges of Agriculture at Cornell University, the universities of Illinois, of Minnesota, of Missouri and of Ohio, and Purdue University; the agricultural colleges of Michigan, North Dakota, Texas, Utah and Virginia; to the Massachusetts Institute of Technology and the engineering departments of the Mississippi, New Mexico and South Carolina Agricultural Colleges, and the Hampton Normal and Agricultural Institute. Silver medals were awarded to the Arkansas, Connecticut State, Hawaii, Kentucky, Maine, New Jersey, New Mexico, New York Cornell, North Carolina, Utah, Vermont (2) and Wisconsin (2) Experiment Stations; to Hampton Normal and Agricultural Institute; the Kansas (2), Michigan, Rhode Island and Utah agricultural colleges; and the agricultural colleges at the Universities of Maine, Minnesota, Missouri, Ohio and Wisconsin; the Massachusetts Institute of Technology, mining department of Nevada State University, department of architecture of Cornell University, Sibley College of Cornell University and Pennsylvania State College. And awards of bronze medals were made to the Connecticut state, Connecticut Storrs, Florida, Hawaii, Kentucky, Louisiana, Missouri, New York state (2) and Pennsylvania experiment stations, and the office of experiment stations; to the agricultural colleges of South Carolina (2), Iowa, Kansas, Massachusetts, Michigan and Oregon; the agricultural colleges connected with Cornell University, and the universities of Illinois, Maine, Minnesota, Missouri, Nebraska, Ohio (2), Purdue (2), Wisconsin and Wyoming; to the Massachusetts Institute of Technology, and the engineering department of the University of Tennessee.

The exhibit was made with a special appropriation from congress of $100,000, which was expended under the general supervision of the government board. Its preparation was in charge of a committee appointed by the Association of American Agricultural Colleges and Experiment Stations, to whose labors, supported by the generous collaboration of the colleges and stations, its success was due. It was by far the most comprehensive and typical exposition of the work of instruction and research at these institutions which has ever been brought together, and its location in the Palace of Education secured for the agricultural departments of the colleges and the experiment stations a recognition of their place among the great educational efforts of the nation. It impressed itself upon intelligent observers as a worthy and consistent exposition of certain features of education and research in the relations of science to agriculture and the mechanic arts.

E. W. Allen.

Office of Experiment Stations,
U. S. Department of Agriculture.

SCIENTIFIC NOTES AND NEWS.

Professor Ernest Rutherford, of McGill University, has been appointed Silliman lecturer at Yale University for 1905. The previous Silliman lecturers have been Professor J. J. Thomson, of Cambridge University, and Professor Charles S. Sherrington, of Liverpool University.

The newly elected officers of the American Physiological Society are: *President,* Professor Wm. H. Howell, of Johns Hopkins University; *Secretary,* Professor Lafayette B. Mendel, of Yale University; *Treasurer,* Professor Walter B. Cannon, of Harvard University. Additional members of the council are Professor R. H. Chittenden and Dr. S. J. Meltzer.

At the seventh biennial convention of the Society of the Sigma Xi, held in Philadelphia, December 29, 1904, the following officers were elected: *President,* Professor Edward L. Nichols, Cornell University; *Vice-President,* Professor T. H. Macbride, Iowa State University; *Recording Secretary,* Professor William Trelease, Missouri Botanical Garden; *Corresponding Secretary,* Professor H. B. Ward, University of Nebraska; *Treasurer,* Professor L. M. Underwood, Columbia University.

The Royal Danish Geographical Society has conferred its gold medal on Captain Robert F. Scott, R.N., the leader of the recently returned Antarctic Expedition.

The council of the Geological Society of London has this year made the following awards of its medals and funds: The Wollaston medal to Mr. J. J. H. Teall, director of the Geological Survey of the United Kingdom; the Murchison medal to Mr. E. J. Dunn, director of the Geological Survey of Victoria; the Lyell medal to Dr. Hans Reusch, director of the Geological Survey of Norway; the Bigsby medal to Dr. J. W. Gregory, lately professor at Melbourne and now professor of geology in Glasgow University; the Wollaston fund to Mr. H. H. Arnold Bemrose for his researches in the geology of Derbyshire; the Murchison fund to Mr. H. L. Bowman for his mineralogical work, while the Lyell fund is divided between Mr. E. A. N. Arber, in recognition of his work in paleobotany, and Mr. Walcot Gibson for his geological work in the Midland Counties of England.

President Eliot, of Harvard University, has been elected a corresponding member of the Academy of Moral and Political Sciences of the Institute of France.

Sir Norman Lockyer has been elected a corresponding member of the St. Petersburg Academy of Sciences.

Dr. George A. Dorsey, of the Field Columbian Museum, and Dr. Alex Hrdlicka, of the U. S. National Museum, have been elected corresponding members of the Society of Anthropology of Paris.

Sir John Burdon-Sanderson, who recently retired from the regius professorship of medicine at Oxford, celebrated his seventy-sixth birthday on December 21.

Mr. John F. Crowell, director of the Buffalo Botanical Garden, will visit Panama during February and March as an agent of the New York Botanical Garden, which will undertake botanical explorations in cooperation with the engineers of the Panama Canal Commission.

Reuter's Agency is informed that Mr. J. J. Harrison has left London for Khartum on his second expedition to the Congo. He intends to travel along the west side bordering on the Nile and Ituri district. He hopes to be able to secure an okapi in the forest region. Mr. Harrison has obtained leave in Brussels to bring home some pygmies.

Associate Professor Frederick Starr, of the Department of Sociology and Anthropology, of the University of Chicago, returned on December 28 from three months in Mexico. It was his fifteenth journey to that country.

Professor Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, has just announced the make-up of the Thirty-Ninth Sheffield Lecture Course for 1905, as follows:

January 20: 'A Journey in Turkestan,' Professor William M. Davis.

January 27: 'Reconnaissance Methods of Exploration in a Mountainous District,' Mr. Howard W. DuBois, M.E.

February 3: 'Powerful Discharges of Electricity,' Professor John Trowbridge.

February 10: 'Bahaman Bird-Life, with special reference to the Nesting Habits of the Flamingo,' Mr. Frank M. Chapman.

February 17: 'The Relation of the Engineer to Society,' Colonel Henry G. Prout.

February 24: 'The Destruction of Pompeii as interpreted by the Cataclysm of Martinique,' Professor Angelo Heilprin.

March 3: 'Alchemy,' President Ira Remsen.

March 10: 'Impressions of Spanish America,' Dr. Rudolph Schwill.

March 17: 'Infectious Disease and Immunity,' Dr. Simon Flexner.

March 24: 'The Physical Constitution and Properties of the Earth,' Professor Robert S. Woodward.

THE thirty-second annual meeting of the American Public Health Association was held last week in Havana under the presidency of Dr. Carlos J. Finley.

DR. ARTHUR V. MEIGS has been elected president of the College of Physicians of Philadelphia.

THE twenty-ninth anniversary of the foundation of the Johns Hopkins University will be celebrated on February 22, when Dr. William Osler will deliver the principal address.

IN a recent issue we stated that Professor Barnard, of the Yerkes Observatory, was to spend the next few months in photographing the sun, at Mt. Wilson, Cal. The observatory is primarily for solar research, but Professor Barnard's work will be the photography of the milky way and the different nebulosities in the heavens, for the observation of which the Bruce photographic telescope is especially designed.

AT the annual meeting of the board of managers of the New York Botanical Garden, held last week, a report on behalf of the scientific directors was presented by Professor L. M. Underwood, chairman, which recommended the erection of four life-size statues on the piers at the front entrance of the museum building, as provided in the original plans of the architect. These statues are to commemorate the work of Samuel Latham Mitchell, David Hosack, John Torrey and John Strong Newberry as the pioneers of botanical science in New York city. The recommendation was approved, and the making of arrangements to carry it into effect was referred to a committee composed of Mr. Charles F. Cox, chairman; Judge Addison Brown and Professor Underwood.

PROFESSOR JAMES WEIR MASON, professor of mathematics at the College of the City of New York from 1879 to 1903, died on January 10 at the age of sixty-nine years.

THE trustees of the Elizabeth Thompson Science Fund announce that income for grants is now available. Applications should reach, before February 14, 1905, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A. 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.

THE U. S. Civil Service Commission announces an examination on February 15, 1905, to fill two vacancies, at $1,000 to $1,200 per annum each, in the position of hydrologic aid, Geological Survey, and vacancies as they may occur in any branch of the service requiring similar qualifications.

The New York Medical Record states that the commission appointed by Harvard University, under the terms of the bequest of $100,000 by Mrs. Caroline Brewer Croft, to study cancer has prepared a report of its labors during the past four years. This report, which is now in the hands of the printer, will, if the advance statements of its contents are correct, contain little that is new. Its conclusions are said to be that cancer is neither hereditary nor contagious, that it is not of parasitic origin, and that excision is the only cure except in the case of certain superficial growths which may be cured by radiotherapy.

The British postmaster-general has made arrangements with the Marconi Company for the acceptance and prepayment at telegraph offices of telegrams for transmission from wireless stations on the coast to ships at sea.

President Roosevelt has sent a message to congress urging the passage of the bill, now before that body, for the reorganization of the medical corps of the army. He says he is satisfied that the medical corps is much too small for the needs of the present army, and therefore very much too small for its successful expansion in time of war.

The local chamber of commerce at Grenoble has opened an industrial museum or permanent exposition of the special products and diverse industries of this region. This is to be supplemented later by an agricultural museum and bourse to show the progress of science as applied to soil cultivation and the best implements for field work, and to facilitate business transactions on the part of farmers and cultivators.

A correspondent writes to the London *Times:* The Carnegie Dunfermline trustees have endeavored to provide secondary and technical education at cheap rates, yet of a quality equal to that supplied in the largest educational centers, and by means of bursaries to bring university education within the reach of all capable and diligent students. They have appointed a musical director, Mr. David Stephen, who superintends the arrangement of concerts and directs the study of music both in the schools and by supplementary classes. They have also charge of a gymnasium and public baths, built at a cost of between £40,000 and £50,000, especially staffed and equipped for the development of physical culture. The trustees engage lecturers of repute and award prizes for the best-kept gardens. They have acquired by purchase the old parish glebe adjoining the southeastern extremity of the Pittencrieff, and have thus foreshadowed the construction of a new approach to the glen. By arrangement with the Crown they have taken charge of the palace ruins, the pathways to which they have greatly improved, and the superintendence of Queen Margaret's Cave Oratory has been transferred to them by the town council. So far the only building contemplated by the trustees is a library with a museum, the present Carnegie library being defective as regards accommodation.

The secretary of agriculture says in his annual report that "during the past year the main building of the Weather Bureau Observatory has been completed, while the power plant, the building from which balloon ascensions and kite flights are to be made, and the magnetic building are being constructed. The physical laboratory for electrical and radioactive effects is being planned, the erection of which will take place in another year. Finally, a comprehensive physical observatory for photographing the sun directly and through the spectrum, for measuring radiation energy by actinometry and bolometry, with their allied equipment, will be required. This complex institution must grow up slowly as plans can be matured along the best modern lines. When the equipment is ready we shall make and send out apparatus for the exploring of the atmosphere to altitudes of from 3 to 10 miles. It is probable that many balloons will be simultaneously liberated from different stations so as to get records of storms and cold waves from their four quadrants. With observations from the magnetic, the electric and the solar physics observatories, opportunity for study will be given to those who believe that the cyclonic and anticyclonic whirls that constitute storms and cold waves are mainly the result of changes in the amount or intensity of some form of solar radiation. It is the purpose to make the research at Mount Weather catholic in its broadness."

The London *Times* states that the annual *conversazione* of the Royal College of Science and Royal School of Mines was held at the college in South Kensington, on December 21.

These annual social gatherings are organized by the Students' Union, of which Professor Gowland is the president, and they form a kind of reunion for old students, many of whom were present at the gathering, which, notwithstanding the fog, was attended by about 500 guests. The company included Sir Norman Lockyer, Sir Arthur Rücker, Mr. Morant, Professor Judd (the dean), Professor Tilden, Professor Perry, Professor Callendar, Professor Gowland and Mr. G. W. C. Kaye (secretary). There were many interesting exhibits in the various departments in chemistry, physics, astrophysics, mechanics, metallurgy, mining, geology and biology, under the direction of their respective professors. The Solar Physics Observatory was open by permission of Sir Norman Lockyer, and a cinematograph exhibition was given, while the college company of the Corps of Electrical Engineers showed a searchlight. Dr. W. Watson, F.R.S., delivered a lecture during the evening on 'Radium and 20th-Century Alchemy,' and this was followed by a concert.

WE learn from the London *Times* that the committee appointed by the British Association for the Advancement of Science to consider the probability of ankylostoma (miner's worm) becoming a permanent inhabitant of coal mines in the event of its introduction has presented an interim report. The committee consists of Messrs. G. H. F. Nuttall, M.D., Ph.D., F.R.S. (chairman), G. P. Bidder, M.A. (secretary), A. E. Boycott, M.D., J. S. Haldane, M.D., F.R.S., and A. E. Shipley, M.A., F.R.S. The following is the summary of the committee's report:—There are many channels by which ankylostoma might be introduced into British coal mines. The conditions found underground in these mines are such that the worm would, in many cases at any rate, probably become firmly established. In view of the expense and difficulty of eradicating the worm from any mine in which it has become established, it is of the greatest importance that preventive measures should be undertaken without delay. Complete eradication does not yet appear to have been ever accomplished. The necessary prevention is best accomplished by the provision of proper sanitary accommodation in the main roads underground and at the pit's mouth, by regulations to prevent pollution of the pit by human fæces, and by the establishment of a limited quarantine system for workpeople from infected areas, with compulsory notification of cases to the home office.

ALTHOUGH only ten years had elapsed since Messrs. Whitman Cross and R. A. F. Penrose, Jr., of the United States Geological Survey, made a careful study of the geology of the Cripple Creek district of Colorado, the people of that state were last year so strongly impressed with the economic importance of a scientific examination of the ground opened by mining operations during that period that they urgently requested a resurvey, agreeing to bear half the expense of the work. The re-examination began accordingly with a thorough revision of the topographic map of Cripple Creek by Mr. R. T. Evans, who acted under the supervision of Mr. E. M. Douglas. The study of the geology and mines of the district was undertaken jointly by Messrs. Waldemar Lindgren and Frederick Leslie Ransome, who were assisted by Mr. L. C. Graton. The examination began in June, 1903, and the field work was concluded in April, 1904. Practically every accessible mine in the district was examined in greater or less detail. A preliminary report on the work, prepared by Messrs. Lindgren and Ransome, has just been published. It is issued in advance of the final laboratory examinations and is a summary of those facts that bear upon the economic development of the region and are of immediate importance to the miners.

THE *Medical Record* states that the construction of the new government laboratory building at Manila has advanced sufficiently far to permit of its being occupied by a number of branches of the Bureau of Government Laboratories. The bureau is composed at present of the following divisions: (1) A serum laboratory at which are manufactured vaccine virus, rinderpest serum, etc. (2) A library in which are to be stored and catalogued all the scientific books in possession of the government. (3) A well-appointed chemical laboratory. (4) An entomological division, which has already done good work in the study of the insects which were destroying the cacao plants of the islands. (5) A biological laboratory, which gives much promise for the future. (6) A botanical division. The large number of plants which remain unidentified gives this division a large field in which to work. There are a number of other branches of this bureau, but they can scarcely be dignified by the name of division, as for instance the branch which takes the photographs for all departments of the government. It has also been proposed to incorporate a division of weights and measures, the necessity for which has already been felt.

Mr. Edgar Speyer, the chairman of this fund, which carries on its work in the National Hospital for the Paralyzed and Epileptic, having been asked by the Hon. Stephen Coleridge, on behalf of the National Anti-Vivisection Society, whether the researches involve experiments on living animals, has sent the following reply:—"Dear Sir,—As you are already aware, the National Hospital is not a place licensed under the Act for experiments on living animals. I am informed, nevertheless, that your society endeavored to prevent subscriptions being sent to it on the ground that some members of the medical staff, in their private capacities, are licensed under the Act. The Nervous Diseases Research Fund is an endeavor to provide funds for research into the origin and cure of those diseases. It will be conducted in the hospital under the advice of the medical staff. That being so, your past treatment of the hospital shows that it has nothing to expect from your society in the way of support. As this removes the only *locus standi* you might otherwise have to interfere, I do not think it necessary to enter further into the subject of your letter. Yours truly, Edgar Speyer. December 14, 1904."

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that Mr. Andrew Carnegie has given $100,000 to Tufts College for the erection of a library building and $50,000 to St. Lawrence University at Canton, N. Y., for a science building.

At the convocation of the University of Chicago on December 20, President Harper announced that Mr. John D. Rockefeller had signified his willingness to contribute to the University for the year beginning July 1, 1905, the sum of $245,000 for current expenses, this being the same sum that he has contributed during the present year. Mr. Rockefeller has also contributed this year $60,000 for the enlargement of the heating plant of the university.

By the will of Mr. Henry Norris, of Philadelphia, the University of Pennsylvania, the University Hospital and Haverford College each receive $5,000.

The will of Macy S. Pope of Brookline gives $25,000 each to the Massachusetts Institute of Technology and the Washington Academy of East Machias, Me.

Mr. Michael Jenkins, of Baltimore, has given to the board of directors of the Maryland Institute a site on Mount Royal Avenue, 200 feet wide and 250 feet deep, for the erection of the building. It will be remembered that Mr. Andrew Carnegie agreed to give $263,000, equal to the assets of the institute, for a building, provided the city supplied the site.

Mr. Eugene G. Blackford has bequeathed to the Brooklyn Institute of Arts and Sciences $5,000, together with his apparatus and books on zoology.

The Rev. Albert Watson, fellow of Brasenose College, Oxford, has bequeathed £4,000 to the college.

It is said that Harvard University and the University of Berlin have practically arranged a method by which a temporary exchange of professors will occur. It is further reported that a similar arrangement has been made between the Massachusetts Institute of Technology and the Berlin Institute of Technology.

Mr. W. E. Allen, professor of biology in Epworth University, Oklahoma City, has resigned to accept a graduate fellowship in zoology at the University of Nebraska, Lincoln.

SCIENCE

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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, 27, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

COOPERATION AMONG AMERICAN GEOGRAPHICAL SOCIETIES.*

IN considering the many ways in which the science having as its special province the study of the earth's surface can be enhanced and its service to mankind rendered more efficient through the agency of geographical societies, five subordinate themes present themselves for consideration. These are: The scope and aim of geography; the methods of gathering and distributing geographical knowledge; the functions of geographical societies; the present status of the geographical societies in America; and in what ways can the geographical societies of this country increase their influence and enlarge their usefulness?

THE SCOPE AND AIM OF GEOGRAPHY.

The proportions of a great mountain seem to vary according to the point of view of the beholder, and the impressions it makes on various minds also vary, as may be said, in reference to their sensitiveness to thought-waves of different length. To the dweller in a vale at a mountain's base, its sublime slopes do not present the same picture that is beheld by the traveler on a neighboring plain; the impressions its weathered battlements awaken in the mind of the untutored savage have but a faint resemblance to the train of thought started

* Address of the vice-president and chairman of Section E—Geology and Geography, Philadelphia, December, 1904.

into activity by the same stimulus in the brain of the geographer. When the name of the mountain is spoken, all of its attributes and all of its subjective influences may be conceived as being embodied in the word used.

In a similar way the word *geography* has many shades of meaning, according to the point of view and the training of the person using it. To the child at school, to the poet, the painter, the man of affairs, the scientific geographer, etc., the word does not have the same significance, and, in fact, in the different connections just suggested, might be thought to refer to widely different subject-matter. To some persons the mountain of earth-lore is far distant—a mere cloud on the horizon—while to other persons it is near at hand, overshadowing in its immensity, awe-inspiring in its magnificence, and its rugged slopes inscribed with the history of ages, while its summit is veiled from view in the cloud-land of the unknown.

The multiple interpretations that may be given to the word geography demand attention, but in order to learn the scope and aim of geography as a science, we turn to the explorers and investigators who have aided in its development. Answers to the question: What is geography? by several of its learned expounders were summarized by Charles R. Dryer,* and a concrete definition extracted from them which reads: *Geography is the science which deals with the distribution of every feature and the environment of every creature on the face of the earth.* The meaning of this crystallized statement is more fully shown in the admirable address referred to by enumerating the several subordinate parts of which geography is the symmetrical whole. These are:

1. The earth as a planet: its form, dimensions, motions and relations to the sun.
2. The land: its outline and relief; the distribution of its surface forms, including streams and lakes.
3. The sea: its outline, depth and contents; the properties and movements of sea-water.
4. The atmosphere: its properties, conditions and movements, and their results as manifested in climate.
5. Plants and animals; their distribution.
6. Man: the distribution and movements of peoples; human conditions, industries, structures and, to some extent, institutions.

While it is no doubt necessary to divide and subdivide the science of the cosmos, both for convenience of study and in order to bring the magnificent whole within the range of human comprehension, the rigid lines established for these and kindred purposes, it should always be remembered, are artificial and nearly always indefinite. There is no inter-science law, corresponding with international agreements, which fixes their bounds. Every student of nature must feel that he can visit his neighbor's fields without being considered a trespasser, and be at liberty to pluck the flowers of truth growing there without being branded a thief. From the hard, dry formulas cited above—although fully appreciating the logical plan for earth-study outlined by them—I would remove the implied limitations as to space and time and introduce perspective. Not only the study of the distribution of land and water, of plants and animals, etc., at the present day should be free to the geographer, but the many combinations of conditions and processes which have led to the present order of things should come within the range of his vision. The 'life history' of every feature of the earth's surface, and the 'life-work' of every process by which those features have been fashioned, together with the

* Charles R. Dryer, 'What is Geography?' An address before the Southern Illinois Educational Council at Carbondale, October 23, 1903, *Teachers' Journal*, Marion, Ind.

changes still in progress, as well as glimpses into the future, are to be numbered among the fascinating problems geography has to present. To the study of the earth's surface may well be added the light, color and motions which give that surface its beauty and variety. I would have the geographer feel that the thoughts of a poet greater than Milton, who 'with no middle flight intends to soar,' are interwoven with the bare statement that the study of earth includes its form, dimensions, motions and relation to the sun. The picture these words outline in the mind reveals a mighty globe, without visible support, revolving in space, and an orderly ebb and flow of its surface waters, in obedience to the same intangible power of gravity; the silent daily change from light to shadow; the pulse-beat of the seasons; the advance and retreat of secular changes in each of these orderly revolutions—all this and more, so magnificent and so inspiring that it can scarce be thought, much less spoken, is by inheritance the right of the geographer and should not be denied him. The earth, like the wayside flower, has a life history, and a search for the records of its birth and growth is of interest to the geographer, even if not included in the strict time limits granted him, and he should have freedom to follow his thoughts wherever they lead. Nor is this all; the geographer who no middle course intends to take, must reach out for the sun and all his attending planets, and search the realm of distant space for meteors, nebulæ, star-clusters and cosmic mists, which in any way may aid in interpreting the story of the earth's evolution. So also in the study of the land, the sea, the atmosphere, and the relation of these to life, and to human history, I would bid the geographer remember that the earth's surface is not fixed and rigid, a dead, motionless thing, but ever changing in response perhaps to the fall of a raindrop or an eruption of Krakatoa, and that it is clothed with beauty of both form and color, and whispers with a thousand tongues to the admirer who inclines a listening ear.

What then is geography? The study of the distribution of earth features and of the environment of living things, to be sure, but also the reading of the fascinating story of the development of those features, and a search for the complex antecedent conditions which gave birth to the present marvelously delicate adjustment of life to its environment. Illuminating this temple not made by hands are pictures of the earth-beautiful, and the many charms that are imparted to nature-study by all that is lovely in form and color, and fascinating by reason of sound or motion on the still developing earth's surface with which man's life is linked and of which his body is a part.

GATHERING AND DISTRIBUTING GEOGRAPHICAL KNOWLEDGE.

The chief aim of the geographer being to gain all possible knowledge of the earth's surface as it exists to-day, and of the history of the changes which resulted in the present order of things, the question presents itself: How is this knowledge to be acquired, and what is to be done with the harvest when reaped?

The popular idea in reference to methods of acquiring geographical knowledge is, no doubt, to traverse unknown lands, make voyages in Arctic and Antarctic seas, and scale mountains never before pressed by human foot. Such enterprises, however, although laudable and commendable in themselves, can not be considered as the most noble or most fruitful of geographical explorations. Geographical advances are to be made not only by crossing ice-fields and climbing mountains, but by excursions into the realm of ideas as well. A modern phase of the science consists in tracing the successive changes various features of the earth's surface have passed through, and in noting the orderly sequence of events produced by the moving agencies still active in modifying and molding the earth's features. This search culminates in the study of the relation of life, and particularly of man to surrounding physical conditions. While the explorer of new lands gathers facts, the philosophical geographer arranges those facts in orderly sequence, interprets their meaning and deduces from them hypotheses, which have for their purpose the discovery of the laws of nature. It is the formulating and elucidating of these laws which constitutes the noblest aim of geographical science. This philosophical stage in the growth of geography has but recently been entered upon, and is the one which is to claim the greatest share of attention in the future.

From this as yet not generally recognized point of view, it appears that fresh fields for exploration surround us on every hand. Some of the most important advances in geography yet made can be claimed as the fruits of home study rather than resulting from explorations in new lands, although based on and supported by extensive field investigations.

Illustrations of this thesis are: the base-level idea, which was given concrete shape and stamped with a name by Powell, the important principle embodied in the term geographical cycle, coined by Davis, and the laws of stream erosion, transportation and deposition so admirably formulated by Gilbert. These and other far-reaching and, as it seems, universal and everlasting doctrines render transparent the clouds which before shadowed familiar scenes and impart to them new significance. The lands to be explored by the scientific geographer encompass us on every hand, and the sea has only just begun to yield up its secrets.

The gaining of geographical knowledge at first hand, or geographical research, consists, then, of both journeying and thinking, and the two are inseparable in order to secure the highest results.

To the question: What is to be done with the fruits of geographical studies when gathered? I could answer curtly: Give them away. Sow the seeds of knowledge broadcast in the minds of men, with faith that some of them will germinate there and multiply a thousandfold. In the harvest of the future, as we may be assured from the principle termed mutation by biologists, every seed will not have reproduced its kind, but new species will appear and rank among the discoveries of the future.

As to methods of geographical research pertaining to individuals, or combinations of individuals, as in organized expeditions or surveys, and the various ways of publishing the results of such undertakings, attention is here invited to only one phase, namely:

THE FUNCTIONS OF GEOGRAPHICAL SOCIETIES.

Aids to Exploration and Research.—As shown by the histories of geographical societies and most prominently by the records of the Royal Geographical Society of London, the mother of them all, they have been most sympathetic to the adventurer and explorer, and have aided in many instances not only directly from their treasuries, but perhaps still more efficiently through their influence on legislation, in starting individual travelers on their way and equipping exploring expeditions. Incident to such direct material aid have been more or less successful attempts to train explorers for this work and furnish them with instructions as to ways of conducting it. The word 'unexplored' has not as yet been erased from our globes, and many mountain peaks are as yet unconquered; the privilege of assisting in such tasks is still open to geographical societies, and by some persons may even now be considered as the chief aim they should have in view.

With the change from traversing unknown areas to exploring the domain of ideas, which made geography a science, the sphere of usefulness of the geographical society has been vastly enlarged and new duties placed upon it. Thus far, however, geographical societies do not seem to have awakened to the full realization of the dignity of this new life, and the vast possibilities it opens for their own growth and elevation. It needs no argument to show that it is a duty of a society having the study of the earth's surface for its chosen field, to foster and encourage geographical research in the laboratory and library, in cultivated fields, and amid hills and valleys, just as truly as it is to aid the African explorer or encourage the mountaineer who would scale Mount Everest.

To be reckoned among the functions of geographical societies, is the search for the exceptional man, not only he of strength of limb who can climb mountains, and of great endurance who can brave the perils of ice-fields or tropical jungles, but the man of broad philosophical ideas and logical mind, who can correlate the facts explorers gather, supplement them by his own field-studies, and deduce from them the laws that have governed the earth's development and still control the winds, the streams, the glaciers and other agencies by which the earth's surface is being modified and changed.

The corner-stone of every geographical society should, therefore, be geographical research, under which term systematic endeavor to enhance any branch of geographical knowledge is included.

Diffusion of Geographical Knowledge.—While an increase in knowledge should be the leading ambition of geographical societies, their greatest activity and chief exertion, as shown by their histories, has been in the direction of spreading or disseminating knowledge already acquired. Activity in this direction is highly commendable and should be encouraged, as it is a most important function; but it is an outcome of research and occupies a lower plane. The means for disseminating knowledge available for geographical societies, as is well known, are: Both popular and scientific meetings, public lectures, field excursions, joint sessions of two or more societies, international congresses, together with the printing and distributing of journals, proceedings, magazines, etc.

Intimately connected with the distribution of a special kind of knowledge from a given center, is the gathering together at that center the records pertaining to the specific aim in view distributed from other centers. One function of a geographical society is, therefore, to maintain libraries of books, maps, charts, and, also, in these later days, of photographs. Necessitated by this and other functions is the ownership or control of a building suitable for library purposes, places of meeting, etc.

Individual Conferences.—All the functions of geographical societies have not been stated, however, when the aids they offer to exploration and study, and their various means of publication are reviewed. There is an important and wide-reaching influence which results from the personal contact and friendly exchange of ideas and experiences between persons engaged in the same or similar lines of work. It is seemingly this phase of the social instinct of mankind, more than any other element in scientific cooperation, which leads to the organizing of geographical societies, and serves to hold their members to a common purpose. The importance and value of the contact of man with man, while dependent mainly on the personalities, breadth of experience and richness of ideas of the men themselves, also influenced in a favorable way by an increase in the number, and a widening of the geographical range, of the persons of the same cult who are thus affiliated. In general, it may be said of the gatherings of geographers, and of those interested in their work, that the good resulting increases in more than a simple ratio with increase in numbers and with a broadening of habitat. The trustworthiness of these statements finds support in the success of the several international geographical congresses that have been held, and is illustrated by the results of the recent International Congress of Arts and Science assembled at the Universal Exposition at St. Louis.

Awakening Interest in Geography.—Still another important function of geographical societies is the influence they exert in awakening and stimulating interest concerning the wonders and beauties of the earth in the minds of the people forming the communities where they are located. By thus catering to the curiosity of people they may be led to inquire more closely into the aims of geographers. This function is analogous to the process of creating a demand in the commercial world, and is not beneath the dignity of a geographical society. Agencies in this direction and exhibitions of maps, photographs, etc., of countries on which public attention is centered, be it South Africa or Manchuria; collections illustrating the industries of such countries, or a similar gathering together of antiquities, etc. The most common of such exhibits is the placing on the platform at a popular gathering, of an explorer or traveler, who, it may be whispered in some instances, awakens greater curiosity personally than for the additions he has made to geography.

Influence on Legislation.—Among the functions of geographical societies is also included the influence they exert or should possess in reference to advising legislative bodies concerning the aid they are asked to extend to expeditions, surveys and research along various geographic lines, in order that public funds available for such purposes may be wisely expended. The recognition of the public importance of several European geographical societies is expressed in their names. One of the functions of the National Academy of Sciences of the United States, in which geography is represented, is to advise congress in reference to scientific matters which have a bearing on legislation or demand legislative enactments. Geographical societies, however, which have no organic connection with governments, may influence their action and lead them to foster and promote geographical work, either directly by means of petitions, or indirectly through the personal exertions of their members, as well as by means of the public press, and in other ways. In the exercise of this function also, large membership and an extensive habitat, greatly enhance the good a geographical society can do, and increases in more than a simple ratio with increase in its membership and the breadth of the region from which its members are recruited.

To summarize: The principal functions of geographical societies are: The encouragement of exploration and research; the holding of meetings for the presentation of information on geographical matters, and eliciting discussion; public lectures; field excursions, etc.; publication of instructive geographical reports, essays, maps, etc.; maintenance of libraries; facilitating personal conferences between men engaged in like explorations or investigations; the stimulating of public interest in matters geographical; and the education of legislators as to the relation of geography to human advancement. Even this suggestive summary does not exhaust the subject in hand; the recognition of work well done, as when a geographical society bestows a medal on an explorer; the assumption of the duties of an executor, as when such a society administers a legacy; the opening of halls for the exhibition of loan collections of various kinds, etc., show that the functions of geographical societies are still wider and more varied than can be discussed at this time.

In connection with this summary, I desire to emphasize the fact, as has already been done in part, that in the exercise of several, if not all its functions, the power of a geographical society to do good and enhance the welfare of mankind increases both with the growth of its ideals and with its increase in numbers.

That the importance and influence of such a society of necessity increase with the lengthening of its roll of members may not be true, but as even the laymen in a society have expressed by the act of becoming members their interest in the ideals for which it stands, and furnish the principal part of the audience to which its professional members address their talks and writings, they furnishing a desirable means for disseminating knowledge, and in this, if in no other way, aid in the fulfilment of the tasks geographical societies undertake. The mere fact that persons interested in geography unite to form societies is, in itself, evidence that by means of such cooperation something is gained which is denied the isolated individual, and so far as experience suggests there is no upper limit to the number that can to advantage unite their efforts in this manner.

THE PRESENT STATUS OF GEOGRAPHICAL SOCIETIES IN NORTH AMERICA.

The leading functions of geographical societies being, as all persons will, I think, concede, the increase and diffusion of geographical knowledge, the inquiry comes home to us: How well are the geographical societies of America fulfilling the purposes for which they exist?

After considerable exploration—analogous to that involved in traversing a new land—but greatly assisted by a recently published paper on the 'Geographical Societies of America,' by J. Paul Goode,* I find that in North America at the present time there are not less than seventeen societies, associations and clubs which have geography in some form as the chief bond which unites their members. A list of these several organizations, together with certain data concerning them, is presented on the next page.

The distribution of these societies, as is indicated in the table, includes in an east and west direction, Boston and San Francisco, and its range in latitude is from Washington to Quebec on the east, and from San Francisco to Seattle on the west. In view of the fact that geography is concerned with the distribution and environment of living things, the narrow belt as measured in latitude inhabited by our geographical societies is suggestive. What are the climatic and other conditions peculiar to this belt of nine degrees, which make it prolific in geographical societies, while the vast region to the north and a nearly equal extent of land to the south are barren in this particular?

Of the organizations referred to, there are perhaps ten which, as declared by their constitution and made evident by their work, can reasonably claim recognition as geographical societies; the remainder are of the nature of social clubs, with geographical features, rather than societies having for their leading aim an earnest de-

* *The Journal of Geography*, Vol. II., 1903, pp. 343–350; Vol. III., 1904, p. 44.

† Quoted from the article by J. Paul Goode, cited above.

LIST OF GEOGRAPHICAL SOCIETIES.

Name.	Location.	Number of Active Members.	Books and Maps in Library.	Annual Dues.	Initiation Fee.	Life Membership.
Alaska Geographical Society†	Seattle.	1,200?	....	$2.00	....	....
American Alpine Club	(Organization incomplete.)	......	....	5.00	....	....
American Climatological Association	....	140	....	7.50	$1.00	....
American Geographical Society	New York.	1,300	40,000 books. 12,000 maps.	10.00	....	$100.00
Appalachian Mountain Club	Boston.	1,500	2,000 books. 1,500 maps.	4.00	4.00	50.00
Explorer's Club	New York. (Organization incomplete.)	......	....	....	....	....
Geographical Society of Baltimore†	Baltimore.	1,725	....	1.00	....	....
Geographical Society of California	San Francisco.	?		5.00	....	100.00
Geographical Society of Chicago	Chicago.	65	....	2.00	....	25.00
Geographical Society of the Pacific	San Francisco.	?	4,822 books. 274 maps.	6.00	....	100.00
Geographical Society of Philadelphia	Philadelphia.	537	900 books.	5.00	....	50.00
Harvard Travelers' Club	Cambridge, Mass.	140	....	2.00	5.00	25.00
Mazama Mountain Club	Portland, Ore.	100	100 books. 50 maps.	2.00	....	25.00
National Geographic Society	Washington.	3,375	1,500 books.	2.00	....	50.00
Pele Club	(Organization incomplete)	......	....	....	....	....
Quebec Geographical Society †	Quebec.	200	....	....	....	....
Sierra Club	San Francisco.	760	....	3.00	....	50.00

sire to increase and diffuse geographical knowledge. The combined active membership of what may be termed *bona fide* geographical societies is over nine thousand. This number in itself is significant of a wide popular interest in geographical matters, particularly among the people of the United States. The condition next in importance to interest in geography, which leads to the organization of geographical societies, is evidently concentration of population. Each of our geographical societies has its home in a large city. It is probable, however, that there are many, many thousands of people outside the cities in which the societies referred to are located, who would join similar organizations if it were practicable for them to attend their meetings. In planning for the extension of geographical societies in the future this great but widely scattered demand needs to receive serious attention.

As is no doubt familiar to most of my readers, our geographical societies have extended important aid to exploration, and in the case of at least two societies, namely, the American Geographical Society and the National Geographic Society, the record in this respect is an honorable one.

In reference to aid extended to geographical research, when not directly associated with or forming a part of the work of an expedition, I have inquired in vain for evidence that our societies have either expended money directly or by awarding medals or by other similar means recognized the labor of those who have striven diligently and successfully to explore the domain of philosophical geography.* Here again an extensive field for enlarging the usefulness of our societies makes itself

* An exception should here be made in recognition of the Elisha Hunt Haner Medal of the Geographical Society of Philadelphia, founded 'for encouragement of geographical research.'

manifest. As shown by a considerable body of evidence that has been gathered, and as is a matter of current knowledge, the greatest efforts our societies have made have been in the direction of disseminating geographical information and attracting popular attention to the results explorers and travelers have brought home. During the year 1903 our geographical societies, clubs, etc., held a total of over 60 home meetings, in part scientific and in part popular; conducted not less than 44 public lectures, and engaged in about 16 field meetings. In addition to these direct methods of spreading information, mostly by addresses and lectures, our societies publish on an average approximating 2,000 octavo pages of printed matter each year. These statistics certainly make a favorable showing, and furnish hopeful signs by which to judge of the possibilities of the future.

The net results just referred to, however, pertain to quantity, not quality. The quality of the work our geographical societies are doing is difficult of even approximate determination, since there is no generally accepted standard of measurement available. This is also a delicate matter to discuss, for the reason that local pride and personal ambition are involved. Certain general conclusions, in this connection, however, seem too evident to be in danger of challenge.

The quality of a popular lecture may be said to be good, when its theme is entertaining and instructive, its presentation clear and forceful, and so adjusted to the audience addressed as to hold its attention and lead to logical and consecutive thought concerning the ideas presented. Since a popular lecture has for its principal aim the dissemination of knowledge, its success depends in a large measure on the number of persons who hear it. Judged from this composite standard, the lectures delivered under the auspices of our geographical societies must in general be adjudged good and their influence wide reaching.

The quality of a scientific session of a geographical society for the purpose of presenting and discussing the results of exploration or the conclusions obtained by painstaking research, may be said to be good when the subject-matter is a contribution to previous knowledge. Added to this quality there should be intelligent and suggestive discussion, bringing to the front various points of view, and showing incidentally whether or not the principal speakers have presented their ideas clearly and logically. The success of a scientific meeting is also to be judged, to a considerable extent at least, by the number of persons in attendance, since one aim, and in general the main desire, is the diffusion of knowledge. Judged by these standards the meetings of our geographical societies must be accredited with having added important truths to the world's store of knowledge and to have exerted a beneficent influence on thought and methods of thinking. In large part, however, the degree of success in the case of the meetings in question has been less than could have been desired, owing to the small measure of encouragement extended by our geographical societies to research, lack of adequate preparation on the part of the audience, and as an element necessary to the dissemination of knowledge, the smallness of the assemblies usually in attendance when questions bearing on scientific geography are discussed.

Success in the case of the publications of geographical societies lies mainly in two directions, one the importance of the additions made to knowledge, and the other the extent to which knowledge is distributed. The pages printed are in the main either popular or scientific, but the highest ideal, as I think may justly be claimed, is attained when both of these properties are combined in an individual production. Enhancing the value and usefulness of the publications referred to is their degree of perfection as books, the facility with which they can be had for reading or reference, and the wideness of their distribution.

Turning to the publications of our geographic societies with these ideas in mind, we find less ground for congratulation than in reference to the lectures and the meetings held under their auspices. Without attempting to illustrate by specific examples, it can, I think, be claimed by an impartial critic that the publications of our geographical societies, when judged as attempts to popularize geographical knowledge, in general lack literary merit, are merely descriptive and do not consistently and with subtlety of purpose lead the reader on to think for himself. As contributions to geographical research the publications referred to clearly contain a few papers that are direct and first-hand additions to science, but the number of such papers is few. Our leaders in geographical research do not as a rule seem to consider the publications of our geographical societies favorable places for putting their results on record.

In reference to the publications under consideration, as specimens of the bookmakers' art, they, as a rule, fall below the standard of the better class of literary magazines. Their appearance is in general not attractive, the illustrations in many instances have not been wisely chosen, and, in general, have been poorly reproduced.

As to the distribution and accessibility to the publications under consideration, it is evident that they are not widely known, and although exchanged with scientific societies in this and other lands, they do not find their way into public, collegiate and private libraries to the extent that could be wished. In part, this lack of what may be termed efficiency comes from the comparatively large number of journals, magazines, proceedings, etc., issued, the lack of demand for the kind of information they contain, and the fact that they are too weak to win their way and attract readers in the face of the competition of scientific writings printed in more attractive and convenient forms. In brief, the efforts of our geographical societies in the direction of publication are widely scattered, in large part the bulletins, etc., issued appear at irregular intervals, are repellant rather than attractive in dress, and in large part are weak when considered as either literary or scientific productions, and do not attain the standard that may reasonably be demanded.

As a summary of the defects of our present system I venture to insist that our geographical societies are not only lacking in unity of purpose, but are antagonistic rather than cooperative. Their influence in each case is local, and their aims narrow and ill defined. In no case has research, the true foundation of geography as a science, been made a prominent feature, and never, so far as I have been able to learn, has it received direct financial aid or popular recognition. Owing to the local character of the societies in question and the narrowness of their respective habitats, the facilities they furnish for men to become acquainted with their fellow workers are much less than could be desired. But the most glaring failures are evident in the general weakness of the publications issued, and the inefficiency of the means employed for their distribution.

This unsatisfactory but perhaps somewhat biased summary brings me to the last subdivision of my theme, namely, the inquiry—

HOW CAN THE EFFICIENCY OF OUR GEOGRAPHICAL SOCIETIES BE ENHANCED?

The chief defects in the present status of our geographical societies being as it appears lack of cooperation, low standards in reference to geographical research and inefficiency in publication, efforts at improvement should be mainly in these directions.

The proposition has been made that by organizing a strictly scientific society with geographical or, as it seems, more precisely physiographical research as its chief aim, membership to be restricted to what may be termed professional geographers, all that can be hoped for in the direction of assisting in the study of the earth's surface in this country by means of such cooperation might be attained. It is at once apparent, however, that such a course would be the adding of one more to the already long list of American geographical societies, thus tending not only to render still more diffuse the amount of energy available for geographical work, but to eliminate the more advanced students of geography from the existing geographical societies, and thus deprive them of the leaven, as it were, which is essential to their progress. The new society having research for its chief end, could not be expected to make exertions in the direction of popularizing geography, and thus aiding in the diffusion of geographical knowledge, which is the chief purpose of many of our existing geographical societies. It can be reasonably claimed, I think, that a geographical society will attain the largest measure of success when it carries on the work of adding to geographical knowledge and the task of popularizing and distributing such knowledge at the same time, as one branch of the operation assists and stimulates the other. Then, too, the proposed society, having research in geography as its chief function, and not being open to non-professional geographers, would, of necessity, be small in numbers, and the expense of maintaining it would fall entirely on geographical investigators whose financial resources, as is generally understood, are meager.

It may also be mentioned in the above connection that the Geological Society of America welcomes technical papers pertaining to most geographical subjects, and will give them a place in its bulletin. Similar courtesies are also freely extended by *The Journal of Geology* and several other scientific periodicals. This greatly lessens the demands of skilled geographers for opportunities to make their results known.

Another plan which contemplates the reorganization of our geographical societies, providing it can be satisfactorily adjusted to the interests of all concerned, has for its chief feature the union of all the geographical societies of North America with the oldest in the list, namely, the American Geographical Society. Under this plan each society effecting such a union would become a chapter of the home society, but retain its own organization and its own property, but unite with the parent society in holding annual meetings and in publishing a monthly magazine. This plan has many commendable features when followed out in detail, and differs but little in its aims from the alternative plan proposed below. The general bearings of each of these schemes for enhancing the welfare of our geographical science will be considered later.

The alternative plan just mentioned is for the several geographical societies now in existence, and such other similar societies as may be organized in North America, while retaining their individual names and autonomy, to unite in a brotherhood of societies to be designated by some appropriate name, as, for example, *The League of American Geographical Societies*, which should provide for one general meeting or congress each year, at such centers of geographical interest as may be decided on, and assume the duty for publishing for all of the affiliated societies. Suggestions more in detail which point the way for securing such cooperation are here presented, it being understood that the first step would be the holding of a convention, at which representatives of each society which might desire to join the league should be present and assist in framing a constitution and by-laws.

A preliminary plan for the organization of such a league as just suggested can at least be outlined at the present time and be made a subject for discussion.

Let the president of each affiliated society be *ex officio* a vice-president of the league. Let each affiliated society elect a member of the council of the league for each 500 of its members in excess of 1,000. Such councilors, together with the vice-presidents, to elect each year a president, secretary, editor and treasurer from the members of the affiliated societies not of their own number. The president, vice-presidents, secretary and elected councilors to constitute an executive council for transacting all business relating to the management of the league.

The functions of the league would be the holding of an annual congress open to all the members of the affiliated societies for the purpose of reading and discussing papers, etc., and the publishing of a monthly magazine or other journal to take the place of the publications previously issued by the several affiliated societies. The expense of each annual congress to be borne by the members in attendance, and the cost of the magazine to be shared by the affiliated societies in proportion to their active membership.

The executive council referred to should have the power to receive into the league additional societies as it sees fit, and to arrange for the enrollment of members who are not on the list of any affiliated society.

Under either of the plans just proposed, namely, a union of various societies in one American geographical society, or a league of societies, the leading advantages to be expected are such as would flow from, (1) an annual congress of American geographers in addition to our present local meetings, and (2) concentration of publications.

1. The advantage of an annual congress, as may be predicted, would be large audiences with wide geographical representation, favorable opportunities for personal conferences and the cementation of friendships, and the encouragement that large and representative gatherings would extend to explorers and investigators to present the best fruits of their labors. To these gains should be added the stimulus such a congress would have in the home cities of the affiliated societies, at which sessions would be held, thus tending each year in an important way to extend the influence and enlarge the membership of some one local society. The greater influence on legislation to be expected from the combined voices of many societies over the efforts of any single, local society, suggests a practically new field of usefulness to the geographers of America.

The chief objections that arise in reference to holding an annual congress of American geographers are two in number: First, the large number of similar meetings now held each year, with which many geographers are more or less closely identified. Whether it is desirable to endeavor to promote still farther this plan of scientific development is indeed a serious question, and one that calls for discussion. The second objection is, that owing to the wide geographical distribution of our geographical societies, the proposed annual meetings would be but meagerly attended by the members of the affiliated societies located at a distance from the chosen places of meeting. Owing to the conditions existing, there would no doubt be a tendency to divide the annual congress into two sections, as has been done in the case of the Geological Society of America; one to hold its meetings on the Pacific and the other on the Atlantic coast. Such a division would lessen the influences for good, for which the congress would be organized, and demands careful consideration.

2. The gains to be expected from a concentration of publications are, to a marked degree, expressed by the fact that the proposed magazine, in case all of our geographical societies united in its support, would start with a circulation in excess of ten thousand, not including libraries or subscribers not members of the affiliated societies. With such a vigorous start rapid growth and a constantly widening influence for many years to come may reasonably be predicted. In the list of advantages is to be mentioned also the desirability of having a large body of correlated information in one series of volumes, instead of in many series, thus securing ready reference, and conferring a blessing on future generations of geographical workers. Perhaps the greatest gain to be hoped for, however, is in the direction of a higher tone and better preparation, that a widely recognized, well edited, well printed and well illustrated magazine would have over the for the most part obscure and indifferently printed proceedings, journals, magazines, bulletins, etc., now issued. Another and important advantage which the proposed magazine would have over several of the publications which it would replace, would be the securing of the services of a competent editor, who should receive adequate compensation for his labor. Again, it may reasonably be expected that an attractive geographical magazine would replace to a considerable extent the popular literary magazines of to-day, and secure a large number of readers outside of the societies from which it derived its main support. A magazine having for its aim the diffusion of all branches of geographical knowledge would be welcomed by tens of thousands of our school teachers and other intelligent people in isolated communities who are debarred from oral instruction by leaders in geographical exploration and research.

In reference to the financial aspect of the proposed scheme, it seems self-evident that at least as great a sum of good as is now attained could be secured at less expense, since duplication of reviews, news items, lists of new books, maps, etc., and, to a considerable extent, of matter contained in leading articles, could be avoided; and, also, because one editor would take the place of several editors. Again, the new magazine, by having a wider circulation than any one, and, as may reasonably be expected, in excess of all the publications it would replace, would be enabled to secure an important revenue from advertisements.

One reason for the failure of our present geographical publications to secure a wide circulation outside the immediate members of the respective societies issuing them is, as it seems, lack of business management, coupled with the fact that the enterprise in hand in most instances is too small to be worth energetic exploiting. The publications referred to are not brought before the public in the manner in which literary magazines are promoted, or advertised in the various ways familiar to book publishers. With the proposed concentration of publications there would also be a concentration of effort in the direction of marketing the products of the several affiliated societies, which all persons interested in the matter must agree could not fail to be far more efficient than the present method, or rather want of method, in that direction.

In this connection, it may be suggested that some plan for having the proposed magazine issued by an influential publishing house demands careful consideration.

An objector to the proposed plan of concentrating geographical publications may, perhaps, say that the standard of the new magazine with its world-wide field and high aims, would tend to discourage the modest student who has his maiden paper to present, and could not afford space for the ambitious amateur who desires to see his name in print. For one, I would meet these objections by admitting their truthfulness, but claim that in the end good would result. The new magazine should be under rigid censorship, in reference to the scientific quality and literary merit of the matter presented. While these safeguards would demand greater care and more serious effort than at present on the part of contributors, they would not debar any one whose work had merit, but serve rather to stimulate all geographers who desire to put the results of their labors on record to strive for high ideals.

From the point of view of the existing geographical societies, it may be claimed that they have developed in response to certain local demands, are adjusted to the conditions that gave them birth, and serve the communities in which they are located better than could be expected if they were more or less merged in a larger organization. Such contentions are no doubt true except perhaps as to the validity of the last clause. The proposed change does not require of any local society or club the obliteration of its individuality. Under the plan for uniting all or a large number of our local societies in one truly American geographical society, there would, of course, be a change of name. If a league were organized present names could be retained and simply another process of publication initiated. The aim in either case should be to maintain the individuality of each affiliated society, and an endeavor to make it if possible even better adapted to local needs than at present. An important aid in this direction .(as already suggested) would result from the influence of the general meetings that would be held at the homes of the various chapters or affiliated societies. Such meetings, as may be judged from the history of the American Association for the Advancement of Science, would stimulate interest in the local chapters to a high degree.

Then, too, a strong, well written and well edited and well illustrated geographical magazine, by presenting a wide view of geography and of its many contacts with other interests, may reasonably be expected to exert a wider influence even in the home city of an affiliated society than any strictly home journal.

In addition to the richer harvest to be expected from an annual congress of American geographers and a jointly published magazine as just considered, earnest and active cooperation among our geographical societies, as may reasonably be expected from such concentration of energy, should lead to their taking the initiative in several other directions. Among such hopes of the future is the securing of a map of North America on a scale of 1/1,000,000, as a contribution to the map of the world in the completion of which certain European societies are interested. Another desirable undertaking would be the publication of detailed instructions for the use of travelers and others, as to how and what to observe, in reference especially to the securing of the best possible illustrations of the results of known physiographic processes, and the recording of facts which are likely to lead to the discovery of new laws. Again, time and money might well be expended in preparing and publishing a dictionary of geographical terms; a bibliography of geographical literature; in assembling a library of photographs, particularly of regions where geographical changes are most active, and in yet other directions.

Beyond the immediate and individual interests of a geographical society, or, what is more strictly true, perhaps, in most instances, the personal ambitions of a few of the members of such a society, is the broader and nobler aim of increasing man's knowledge of his dwelling place, and of widely diffusing such knowledge. In order to cultivate this larger field, the local society may reasonably be asked to relinquish, if necessary, some of its local prerogatives and look for compensation in the general advance that would be facilitated thereby. Among such restrictions the fact is to be recognized that should a society cease to publish directly, its returns from an exchange of publications with other societies would cease. Compensation for such losses might perhaps be looked for in a decrease of expenses for editing and printing, and might be made good by placing all the 'exchanges' received in return for the proposed magazine in the custody of some one society and thus striving to maintain one complete geographical library, which could be consulted directly, or its books, maps, etc., loaned to individual students.

In proposing the application of modern business methods in the concentration of geographical factories, as our societies may be termed, I wish to direct attention to the fact that geography more than any other science is best adapted for the purpose of general or popular education. Added to the fascinations of exploration we now have the equally absorbing results of scientific physical geography, pertaining to the fields through which we walk, the brook whose murmurs have appealed to us since childhood, the waves that beat on the shore where we perhaps spend our vacations, and many other equally familiar scenes. The ability to read the history of the earth at first hand should be within the reach of every civilized man, woman and child. It is in order to secure to all the people in North America this means of public education, coupled with never ending pleasure and a constantly expanding mental horizon, that our geographical societies are asked to unite their efforts.

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SECTION E—GEOLOGY AND GEOGRAPHY.

GEOLOGY and geography together occupied a large share of the attention of the members of the American Association for the Advancement of Science at the third Philadelphia meeting of the association, which was held at the University of Pennsylvania, December 28–31, 1904. Section E, 'Geology and Geography,' of the association held its regular meeting on December 28, the principal feature of which was the address of the retiring vice-president, Professor Israel C. Russell, of Michigan University, on 'Cooperation among the American Geographical Societies. The following delegates were appointed to represent the societies named, in the consideration of Vice-President Russell's address: for the American Geographical Society, Cyrus C. Adams, of New York; for the Chicago Geographical Society, Professor J. P. Goode, of Chicago; for the American Climatological Association, Dr. W. F. R. Phillips, of Washington, and Dr. J. C. Wilson, of Philadelphia; for the American Alpine Club, Professor Angelo Heilprin, of Philadelphia; for the Harvard Travelers' Club, Professor W. M. Davis, of Cambridge; for Mazamas, Dr. T. Brook White, of Washington; for the Pelé Club, Professor Robert T. Hill, of New York.

The general program was introduced by

Professor A. P. Brigham, of Colgate University, with a paper on 'Early Interpretations of the Physiography of New York State,' in which were recounted some of the views expressed concerning physical features of the empire state in the early decades of the nineteenth century, and the years preceding. Among the travelers who placed themselves on record was Timothy Dwight, president of Yale College. He and others discussed the origin and retreat of Niagara Falls in ways that forcibly suggest views held to-day. In observing the waters of the Great Lakes and their connecting streams, the tendency toward grade and the base-level was recognized, though not of course in the terms or with the full consequences of modern doctrines. The gorge of the highlands, the deposits in the Hudson valley, and the features of Little Falls, received much notice, and the older writers were quite familiar with the extension of Lake Ontario which we now call Lake Iroquois. On the whole the prophecies of modern views are numerous and full of interest.

In a paper on 'The Menace to the Entrance of New York Harbor,' Professor Lewis M. Haupt discussed the projects which have been and are now being carried on by the general government for improving the channels of the Lower Bay. Up to 1886, the ruling depth on the bar was 23.3 feet at mean low water, which permitted the passage at high water of a vessel drawing 27 feet. At the meeting of the American Association at Buffalo in the summer of that year (1886), Professor Haupt read a paper on the method of improving this entrance by natural forces, but the government concluded, notwithstanding the unanimous report of one of its boards of engineers, to resort to dredging to create a 30-foot channel, 1,000 feet wide, which has been secured and maintained after the removal, up to October, 1891, of 4,875,079 cubic yards at a cost to date of $1,967,-111.82. These depths not meeting the requirements of the port, facilities are now being increased by the opening of the Ambrose channel, seven miles in length, crossing the central part of the bar, by dredging therefrom 42,500,000 cubic yards, provided it shall not cost more than $4,000,000, or less than ten cents per yard.

By means of charts covering a period of 125 years, it was shown that the inlet to Jamaica Bay has moved westwardly seven miles in that time and that the deposits which were formerly arrested in that bay have now drifted past and are rapidly approaching the outer scarp of the New York bar. This one bank of sand contains some 65,000,000 cubic yards, while, on the other flank, the spit at Sandy Hook has advanced about a mile and is now moving into the bay, where it deposits a half million yards on the point every year, to say nothing of the sand held in suspension and which has been removed by dredging. The great quantities of drift thus advancing steadily into the entrance are becoming a serious menace to the harbor.

The remedy which Professor Haupt proposes consists of a single reaction training wall extending along the southerly side of the Ambrose channel to concentrate the ebb currents and the arresting of the littoral drift which will so soon convert Coney Island and Manhattan Beach into interior lagoons. The cost of this work would be less than one half of the present contract which guarantees no channel, as it is filling up even where dredged far below the requisite depths.

Dr. J. W. Spencer, of Washington, D. C., submitted a communication on 'The Submarine Great Cañon of the Hudson River,' in which he collated the results of soundings which have been made during a period of more than a century, but especially those of the last forty years. Professor

J. D. Dana first recognized the submarine channel of the Hudson as evidence of late continental elevation. Lindenkohl first perceived the cañon-like character of the outer portion of the channel near the border of the continental shelf, where the channel suddenly becomes a gorge 2,400 feet deep in the submerged plain. Lindenkohl thought that the cañon was terminated by a bar, but Dr. Spencer has determined that no bar exists and that the cañon cuts through the edge of the continental bench about eight miles farther. It then widens to a valley which can be readily recognized for an additional twelve miles and to a depth of 9,000 feet at a distance of 71 miles from the head of the submarine channel near Sandy Hook. The cañon is double, the upper part being four miles wide while the inner, lower, more sinuous portion is less than two miles across. The period of great elevation, amounting to about 9,000 feet, coincides with that of the early pleistocene. Since that time there has been a subsidence to somewhat below the present level, followed by a re-elevation of 250 feet as seen by the shallow channels of the continental shelf. The region is now sinking at the rate of two feet a century and is undergoing other and less important changes.

In a second paper on 'The Improbability of Land in the Vicinity of the North Pole,' Dr. Spencer said in part:

When Dr. Nansen discovered the deep Polar Basin, sharply defined by a continental shelf, 300–350 miles wide, north of Siberia, with this continuing to Spitzbergen, situated in its very edge, it was proof that no land was to be expected rising out of the basin until the continental shelf on the American side should be reached. The broad Siberian shelf continues even north of Bering Straits, and there are soundings which suggest the location of its approximate border. Alaska encroaches upon this shelf apparently to near its border, thus reducing its breadth to probably 50 miles. Beyond into Beaufort Sea, the Mackenzie River empties by a fjord known to a depth of more than 1,140 feet and another from behind Bank's Land of 1,836 feet, not far from its own head far within the line of the islands. Among the islands another of the discovered fjords reaches to more than 2,400 feet. All of these features prove that the archipelago of high mountains is only a dissected plateau, now sunken and with drowned valleys between the islands, which valleys incise the continental shelf in such manner as to indicate that the shelf itself can not extend far beyond the outer line of the known islands. A sounding about 30 miles north of Grinnell Land, with a depth of 432 feet further suggests that the edge of the shelf is being approached, for the outer margin of this seems to be limited by a depth of about 300 feet beneath sea level. From these submarine topographic features, which are the very best guide, the author supposes that no important islands exist beyond the line of the known archipelago, and that the deep polar basin reaches for 300 or 350 miles from the pole, aproaching the American continental shelf north of Grinnell Land.

The formal sessions of Section E closed with the reading of the following papers by title in the absence of their authors: 'The Structure of the Central Great Plains,' by N. H. Darton; 'Typical Desert Deposits of Eastern Persia,' by E. Huntington; 'Interpretation of certain Laminated Glacial Clays, with Chronologic Deductions,' by C. P. Berkey; 'The Fossiliferous Beds of Sankaty Head, Nantucket, and Their Age,' by Myron L. Fuller; 'On the Jagersfontein Tiffany (Excelsior) Diamond, Weight 971¾ Carats,' by George F. Kunz; 'On Some Pegmatyte Veins of California,' by T. C. Hopkins; 'The Petrography of Belvidere Mountain, Vermont,' by V. F. Marsters, and 'Evolution of some Devonic Spirifers,' by A. W. Grabau.

The sessions of the succeeding days of the general convention were given over to the Geological Society of America. The vice-president and chairman for section E for the next annual meeting of the association is Professor William North Rice, of Wesleyan University, Middletown, Conn. The secretary of the Philadelphia meeting holds over, by constitution.

Edmund Otis Hovey,
Secretary.

SECTION G—BOTANY.

During the recent meeting of this section at Philadelphia, the following items of business of public interest were transacted.

Professor C. R. Barnes, University of Chicago, Professor F. C. Newcombe, University of Michigan, Dr. D. T. MacDougal, New York Botanical Garden, Professor H. M. Richards, Barnard College, and Dr. Burton E. Livingston, University of Chicago, were appointed a committee to confer with a like committee from the Society of Official Agricultural Chemists on the meaning of the expression 'Plant Food.'

The council of the association appointed as delegates to the International Botanical Congress, to be held at Vienna during the coming summer, Professor C. R. Barnes, University of Chicago, Mr. C. L. Shear, U. S. Department of Agriculture, and Dr. H. C. Cowles, University of Chicago.

Dr. Erwin F. Smith, U. S. Department of Agriculture, was elected vice-president and chairman of this section for 1905.

A joint session was held with the Mycological Society on Friday afternoon.

The following are the abstracts of papers offered:

Stages in the Development of Sium cicutæfolium: George Harrison Shull.

There is great range of variation in the leaves of *Sium cicutafolium*, the first nepionic leaf being the most variable and the bracts in the region of the umbel least variable. The juvenile leaves and the senescent leaves, which have been interpreted as atavistic, are shown to disagree with each other in almost every particular. The only cases in which the ancestry of a species is definitely known indicate that whatever change of structure gives rise to new adult characters also results in changed juvenile and senescent characters. The relative simplicity of the juvenile and senescent leaves is due to physiological causes having no essential bearing on the phylogeny of the species. *Sium* is mesophytic, hydrophytic and xerophytic at different periods of its development and these structural differences are associated with, but appear to be independent of, their appropriate environmental conditions. They are not a direct effect of the environment, but are due to the peculiar mechanism of the protoplasm. Rejuvenescence is the process by which protoplasm is changed from the senescent to the juvenile condition. This may result through sexual reproduction or may be brought about in other ways. In *Sium* it occurs regularly in the lateral buds at the base of the stems and may, under special conditions, occur in any other vegetative bud or even in the flower buds. In passing from less complex to more complex leaves the new characters consist in incisions or indentations above the base of the leaf, so that, in pinnate leaves, the proximal pairs of leaflets are homologous, and other pairs which are of like order counted from the proximal pair are likewise homologous.

Alternation of Generations in Animals, from the View-point of a Botanist: Charles J. Chamberlin.

This is an attempt to show that the egg with its three polar bodies, and also the primary spermatocyte with the four spores which it produces, constitute sexual generations comparable with the gametophytic generation in plants. The argument is based upon: (1) The gradual reduction of the gametophytic generation in plants with the gradually lessening interval between the reduction of chromosomes and the process of fertilization, and (2) upon the phenomena of chromatin reduction in both animals and plants.

The theory has no bearing whatever upon relationships and it does not contemplate any homologies between any organs of animals and plants.

Anatomy of Foliaceous Cotyledons: FRANCIS RAMALEY.

Foliaceous cotyledons occur in many species of dicotyledons, yet in form and structure they are never exactly like the true leaves of the same plant. Any cotyledon, however, which is of herbaceous texture and has a leaf-like form may be described as 'foliaceous.' The term is especially well applied to those cotyledons which increase greatly in size after leaving the seed and act as photosynthetic organs for a long time. In the many species of both temperate and tropical plants thus far studied certain rather constant differences between leaves and cotyledons have been noted. The lamina of the cotyledon has usually a looser palisade than the leaf; it has stomata on both surfaces even in those cases where the leaf has them only on the under side. Stomata are, however, not so closely placed as in the leaf. Vascular tissue is less well developed in the cotyledon, as may be easily seen by examination of cross-sections of cotyledon stalk and leaf petiole. In the former the bundles are smaller than in the latter, also fewer and differently arranged. Stereom is usually not developed in the cotyledon stalk.

The Botanical Institute at Buitenzorg: FRANCIS RAMALEY.

The Botanical Institute at Buitenzorg has the best facilities to be found anywhere for the study of tropical botany. Practically all the trees in the large garden are arranged according to plant families, so that it is possible to get, in a short time, a good idea of the members of any particular group. The similarity of the flora of Java to that of the American East Indies makes Buitenzorg especially attractive to our countrymen who expect to do botanical work in the Philippines. The excellent library, the well-equipped laboratory, and the large staff of investigators all go to make the place worth visiting. And more than this—the director, Dr. Treub, is anxious to have visitors to the gardens and does everything to make their work profitable to them. The botanist, no matter what his specialty, will find here always ready and at hand an abundance of material for observation and study. Probably nowhere else can he learn so much in so short a time.

Polyembryony in the Genus Pinus: J. W. T. DUVEL.

The occurrence is reported of two or more fully developed embryos in each of the following species of pines: *Pinus coulteri* Lamb., Coulter's pine; *flexilis* James, limber pine; *jeffreyi* 'Oreg. Com.,' Jeffrey pine; *lambertiana* Dangl., sugar pine; *murrayana* 'Oreg. Com.,' lodgepole pine; *ponderosa* Laws., bull pine; *radiata* Don., Monterey pine; *rigida* Mill., pitch pine.

Observations on the Teratology of the Pineapple: MEL T. COOK.

The term 'teratology' is used with a very indefinite meaning. It is very probable that a careful study of teratology will be of some service in taxonomy and morphology. Thirteen types of variation on the smooth 'cayenne' variety described. Many have been caused by the character of the stock, the method of cultivation or the character of the fertilizer.

The Development of the Microspores of Vallisneria spiralis: Robert Bradford Wylie.

The staminate flowers of *Vallisneria spiralis* are borne in clusters, each containing often as many as two thousand flowers surrounded by a spathe. This group of flowers crowded upon the short conical axis is homologous with the single pistillate flower found within its spathe. The individual flowers are very small, simple, and contain usually less than one hundred pollen grains. The staminate flower may therefore be considered as a pollen carrier since the microspores are not shed, but are lost to the stigmas by the pollen producing flowers. In their development the upper flowers on the axis develop earlier than do the lower ones; the terminal one is conspicuously more advanced than those adjacent to it. The mature flower always shows four pollen sacs, but a study of their devlopment shows that each of these may arise from a single sporangium or by the fusion of two sporangia. It follows that the single (?) stamen may have from four to eight sporangia; the number seems to vary indifferently even in flowers of the same cluster. The microspores have a single coat which is thin and slightly spinous. The male cells are developed while the spores are still in the sporangium. The male structures clearly show their morphology as cells rather than as nuclei only, and remain joined end to end while in the pollen grain.

Note on the Morphology of the Cyperaceæ: Amon B. Plowman.

Queva, in his study of the anatomy of certain monocotyledons (Lille, Travaux & Memoires, No. 22, 1899), has described the occurrence of concentric or amphivasal fibro-vascular bundles in the nodes of *Gloriosa,* and has concluded that these bundles are the result of the anastomotic conditions attending the transition of the bundles from the main axis to the axillary branch. Among the Cyperaceæ it has been found that amphivasal bundles occur in practically all nodes of plants bearing well-developed leaves, whether branches are produced or not; while, on the other hand, in those forms of which the leaves are rudimentary, no amphivasal bundles are present, even in nodes where branches of considerable size are given off. Hence it appears that the occurrence of amphivasal bundles in this group is related to foliar rather than to ramular differentiation of the stelar structures.

Dictamuus Albus L. (D. Fraxinella Pers.), Gas Plant: W. J. Beal.

This is an herbaceous perennial of the rue family (Rutaceæ).

The pistil is compound, deeply lobed, consisting of five carpels, each containing two to three seeds, 'each carpel, when ripe, splitting into two valves,' which divide into an outer and an inner layer. In other words, when mature, a considerable portion of the endocarp separates from the exocarp and at once each half begins to make the attempt to twist in opposite directions, much in the manner of the ripe half carpels of a vetch or pea. In this operation the half endocarps press the apical portion of the carpel wide open. A slight ridge on the inner edge of each margin of the carpel prevents for a time the escape of the twisting endocarp. The placenta separates into another thin trough-like piece, the margins of which are inside of the endocarp. The two seeds separate from the placenta, which sets loosely over the seeds, preventing them from falling out in case the branch bends down toward the ground. Seeds are torn off the placenta as this dries, shrinking away in the central portion and lastly at the ends, which approach each other slightly. Each half endocarp resembles in a general way the capital letter J. The apical portion of the endocarp presses outward, while the basal portion tends to twist inward. When dry enough, and the carpel spreads open well, if the stems are jarred against each other by wind or animal, or the carpel pressed laterally or from each extremity, a sharp explosion follows as the half endocarps complete their twisting, thus liberating the thin placenta and throwing out the seeds. When left to themselves in a quiet place where there is no artificial pressure, the tension of the endocarp at length forces its way out, sometimes sending one or both seeds seventeen feet, possibly in some cases aided somewhat by the wind. Next to an examination of the parts as they develop, is to see models shaped like ripe pistils. The black, smooth seeds are nearly spherical, with a short neck. The seed is nearly 4.5 mm. long, by 3 mm. or more in transverse diameter. In size they are much like those of *Vicia sativa.*

The Value of the Diatoms in Determining the Direction of Ocean Currents and the Origin of Sea-bottoms: ALBERT MANN.

The investigation of the Diatomaceæ contained in the United States sea-dredgings and hydrographic soundings has brought out the fact that these organisms are a sure and the only sure index of the origin of sea-bottoms and incidentally of the extent and direction of sea-currents. This comes from four facts: (1) The indestructibility of diatom frustules, (2) their extreme minuteness, lightness and hence transportability, (3) their enormous numbers in genera and species, (4) the great differences between recent and fossil diatoms; between fresh-water and marine diatoms; between tropical, temperate and arctic diatoms. Illustrations of the foregoing facts from the dredgings and soundings examined; need of this work, especially in classifying and tabulating the characteristic diatoms of the different sea-bottoms.

Economic Methods in Restocking White Pine Forests: F. WM. RANE.

At present white pine lumber is getting scarce and hence its value is increasing. There is no lumber that can be depended upon to take its place and the economic problem of growing this tree for future lumber is deserving of much study and experimentation. This paper gives the data obtained from experiments in utilizing natural seedlings, showing that by their use much economy can be practised in restocking waste lands and in reconverting pine forests into new forest growth. By utilizing these seedlings, which at present have little or no value, the whole expense of restocking lands to forests can be accomplished at less expenditure than the original cost of the plants themselves when purchased from a nursery. Experiments outlined show that one thousand three-year-old seedlings can be dug and transplanted at a cost of one dollar and twenty-five cents a thousand. The nursery price varies with various sections and the quantity purchased, but it is safe to say that the first cost of seedlings from this source is much larger than the total expenditure of digging and setting in the former.

The Principles of Phytogeographical Nomenclature: PEHR OLSSON-SEFFER.

(1) Clearness and conciseness are the main requisites for a system of terminology. (2) Each technical term should have only one meaning. (3) In case of doubtful terms consult the proposer of the name. If the conception it represents is not absolutely clear, the name has no status in nomenclature. (4) If a term has been commonly used and understood in another sense than the original author proposed, it

should be retained, but only in case there can be no doubt as to its interpretation. (5) If a conception has already received a name and there is no obvious reason to discard that name, an author has no right to propose a new term. (6) A law of priority is practicable, we think, only so far as the principles laid down in the previous pages of this article will admit. (7) A name, the conception of which has materially changed in the course of time, naturally has no standing. (8) A technical term should be associated in our mind with the idea it represents. (9) A technical term should be clearly defined so as to leave no doubt as to its significance. Authors should, therefore, desist from proposing new terms in mere catalogues. (10) A new term should be published in some work accessible to scientific workers. (11) Vernacular names should not be excluded from phytogeographic nomenclature, but they must in every case be definite and give rise to no ambiguity. (12) An international committee of phytogeographers should be appointed by the Vienna congress, to continue the work on a proposed code of rules. (13) This committee should consider what kinds of technical terms are needed; how they should be classified, *f. i.*, with regard to distribution, abundance, elevation, phenological phenomena, etc. (14) The result of the work of the committee already existing, and of the succeeding one, should be published at an early date, so as to give the public ample time to discuss the various phases of the question before the following congress assembles.

The Cycadofilices: David White.

The 'cycadofilices' (Pteridospermeæ) comprise a group of Paleozoic fossil plant genera which, as the name implies, are intermediate between ferns and gymnosperms. The structure of the stems, roots and petioles shows a mingling of filical with cycadean characters; the fronds are typically filicoid, as also would seem to be the little-known microsporangia; but the seeds, definitely recognized in but three genera, appear to agree in their main features with the primitive (fossil) gymnosperms. The paper describes the more important or striking characters as yet discovered in these remarkable types, which, in general, antedated the cycads.

Suggestions from the Study of Dairy Fungi: Charles Thom.

The demands of certain economic problems emphasize the necessity of finding more certain and more uniform means of describing and determining common saprophytic fungi. The intimate connection between most of these problems and bacteriological questions suggests the desirability of seeking such methods of description in their physiological and morphological relations to well-known culture-methods and media. A dairy problem would indicate the methods of the dairy bacteriologist as to some extent necessary to make the work of practical value. Following these suggestions a series of dairy fungi have been cultivated upon such media through many generations. Certain species of *Penicillium* have been grown in hundreds of cultures to ascertain the comparative value of the observations made upon several substrata. In spite of wide variations on different substrata a remarkably constant series of characters have been secured which recur regularly upon the media used. These results suggested the utility of a diagrammatic summary upon the general plan used by the bacteriologists which should be useful for contrasting the characters of different species. The characters found of value in the genus *Penicillium* are reaction to litmus-media, liquefaction of gelatine, variations in color of colony, structures appearing at the margin of the rapidly growing colony, general surface effect of the colony, the relations of the conidiphore and conidial fructification, the description of the conidia themselves, with occasional unique characters which identify special forms—such as the formation of sclerotia. Cultures, diagrams and card descriptions of species of *Penicillium* were presented to illustrate the characters mentioned.

The Asciferous Stage of Glœosporium Psidii: John L. Sheldon.

By means of artificial cultures and inoculations, Dr. Sheldon was able to study the life-history of *Glœosporium Psidii* G. Del., a fungus which causes the 'mummy disease' of the guava. The *Glœosporium* stage of the fungus closely resembled the *Glœosporium* stage of the 'bitter-rot' fungus (Glomerella) of the apple as determined by himself and other investigators. In old cultures on apple-agar, masses of perithecia were produced which resembled those of *Glomerella* both in shape and in structure, and also in the size and shape of the ascospores. The results indicate that the two fungi may be identical, although there were certain characteristics of the two that were not quite the same. The investigation will be continued.

Cytological Studies of Sapromyces and Rhipidium: Cyrus A. King.

Sapromyces and *Rhipidium* both belong to the Septomelaceæ, which family is placed by Schroeter in the Saprolegniineæ.

In zoospore formation the individuals are separated by the severing of connecting cytoplasmic meshes. This process begins on the interior if there is a vacuole present. In some cases, at least, there is an indirect nuclear division in the zoosporangium of *Sapromyces*. In the oogonia of *Sapromyces* there is one mitosis and there is probably one in *Rhipidium* also. In both forms during oogenesis the supernumerary nuclei migrate to the periphery where they are cut off in a periplasm. This periplasm in *Sapromyces* is very rudimentary. The fertilization tube in *Rhipidium* is of oogonial origin, although it is possibly of antheridial origin in *Sapromyces*. A conspicuous differentiated region corresponding to the oocentrum of Trow is seen in *Rhipidium*. The reticulations on the oospore wall of *Rhipidium* are probably homologous with the radiating walls between the peripheral cells of *Acosospora*. The structure of the oogonium and the processes in oogenesis show this group to be related to the Peronosporineæ and it is suggested that they be placed in this cohort as follows: Peronosporineæ—Albuginaceæ, Peronosporaceæ, Septomelaceæ, Saprolegniineæ—Saprolegniaceæ.

A Study of the North American Coleosporiaceæ: J. C. Arthur.

A list of twenty-four species is presented, some of them now described for the first time. The presentation chiefly deals with the method employed in discriminating between the species, their degree of relationship, and their distribution.

Nomenclatorial Type Specimens of Plant Species: A. S. Hitchcock.

In systematic botany there is an increasing tendency to base species upon definite specimens. Older authors did not do this. It becomes necessary to decide upon rules for selecting the specimen upon which species should be based when these are not definitely indicated. The present paper is a discussion of such rules.

Cultures of Wood-Inhabiting Fungi: Perley Spaulding.

It has been found easier to make cultures of wood-rotting fungi from actively growing mycelium than from the spores. Agar made from infusions of the species of wood which the fungus is found upon, usually serve to start growth of the mycelium at first. They can then be transferred to tubes of sterilized green wood of the suitable species. Cultures of *Lenzites sepiaria* and *Schizophyllum commune* have yielded fruiting bodies, the latter in about five weeks' time. The spores of the former were germinated in a very weak cane sugar solution, but failed totally to germinate in water or in weak salt solutions. Inoculations with mycelium of *Lenzites* have given no parasitic action, but in cut timber they have produced fruiting bodies in less than five months.

The Effect of Climatic Conditions on the Vitality of Seeds: J. W. T. Duvel.

This paper is a preliminary report on experiments undertaken to determine the effect of climatic conditions on the vitality of seeds when stored in the ordinary seed packages and in air-tight containers.

In December, 1902, seeds were distributed to sixty stations throughout the United States, including Alaska, Hawaii, Porto Rico and the Philippines. In addition seeds were also stored in Newfoundland, Canada, Isle of Pines, Cuba, Jamaica, St. Kitts, Dominica, Barbados and Trinidad. At the expiration of six months and one year respectively two complete sets from each of the sixty stations were returned and tested for vitality. The results of the germination tests show a great deterioration in the seeds contained in paper packages which were stored in places having a warm, humid atmosphere, while the seeds put up in air-tight containers preserved their vitality much better under these conditions. Seeds from places having comparatively dry climates showed no appreciable loss in vitality from either the paper packages or the air-tight containers.

The Germination of Seeds as affected by Soil Temperatures: Edgar Brown.

A brief description of observations on the temperature of the upper layers of soil and the effects of soil temperatures on the germination of seeds. From March 26 to June 30 planting of twenty different kinds of seeds were made at intervals of from two to three days, and records were kept of the total germination and appearance of first sprouts.

Readings of soil thermometers at depths varying from one fourth inch to two feet and of air and solar radiation thermometers, were made from 5 A.M. to 10 P.M. at intervals of fifteen minutes. Great variations in germination resulted. Lettuce germinated well in the early part of the season when the temperature was comparatively low, but poorly later as soil became warmer. The reverse was true of corn and many other seeds.

The time between planting and the appearance of first sprouts was generally inversely proportional to the per cent. of germination. Seeds of low vitality germinate much more slowly than seeds of high vitality. Seeds of *low* vitality are much more affected by unfavorable conditions than seeds of high vitality.

The Relation of Transpiration to other Functions: Burton E. Livingston.

The subjects for study were wheat plants grown in soils and nutrient solutions. The respective amounts of water lost by transpiration during a period of two or three weeks in a synchronous series of cultures in different soils or in different solutions appeared to be a good criterion for judging the relative values of these different media. To test this more rigidly, total transpiration was compared in a large number of series with the weight of the leaves and with their area. It was found that through a wide range of treatments transpiration is proportional to leaf area. The relation of transpiration to leaf weight seems not to be quite so simple, although by this criterion the different treatments in a series would fall in the same order as by that of transpiration. In other words, transpiration per unit area is quite generally uniform throughout a series, while that per unit weight varies slightly. The amount of variation in the last case is far too small, however, to interfere with the use of transpiration as a criterion for estimating relative leaf weight. The conclusion from these tests is simply that *soils or solutions may be compared, in respect to their power to support growth, by means of total transpiration of the plants growing therein.*

A number of studies were presented of the relation of transpiration to absorption of salts in water cultures. In a series of cultures with identical treatment excepting for the use of different solutions, transpiration (since it is proportional to area and weight of the leaves, and therefore to growth of the plant) is found to be proportional to the amounts of salts absorbed. But when one culture is grown in a moist air and another in a relatively dry one this relation fails. A moist air (such as that in a bell-jar), as is well known, checks transpiration to a marked degree. It checks absorption of salts to a very slight degree, often not at all.

Further Notes on the Physiology of Stigeoctonium: Burton E. Livingston.

The alga is the same as that on which the author has studied the effects of external osmotic pressure, drying and the presence of cations. The three above-named conditions cause filaments to assume the palmella form. It is now found that the effect of low temperature (2° to 10° C.) is nearly identical with that of the mineral poisons. Thus the palmella form is produced from filaments but zoospores are not inhibited, although there was no stimulation of zoospores observed.

In sea-water the alga lives and grows slowly as the palmella form. In sea-water diluted with distilled water to one hundred times its volume the same response occurs, showing that, although natural sea-water has an osmotic pressure high enough to produce the change, yet there is present a poison which will produce the same effect without the physical stimulus. It is apparent from the studies on metals that this poison must be either anionic or organic in its nature.

Further, water from peat bogs, although it has no appreciable osmotic pressure, causes the alga to change from the filamentous to the palmella form. It is probable that here we are dealing with an organic substance in small quantities. The observation is of special interest in connection with the xerophytic structures of bog plants, seeming to suggest very strongly that the explanation of such structures lies in the presence in the bog water of some organic poison. The toxic property of this water is not proportional to its acidity.

The Salt Water Limits of Wild Rice: Carl S. Scofield.

Wild rice (*Zizania aquatica* L.) is naturally a fresh-water plant, and abounds in streams flowing into salt water along the Atlantic coast. An investigation was made to determine the salt-water limits of the plant. Three delta regions were surveyed, and the water both inside and outside the wild rice field was tested by an electrical conductivity method. It was found that where the water surrounding the plants is more saline than the equivalent of 0.031 normal solution of sodium chloride, the growth of wild rice is nearly or quite inhibited.

Notes on the Vegetation of Onondaga Lake: J. E. Kirkwood.

Onondaga Lake is situated in central New York and is known chiefly through the existence of certain salt springs on its shore. These springs impart a salinity to a considerable area of the marshy lowlands about the lake and a conspicuous holophytic vegetation has sprung up. The plants thus far observed which are characteristic of salt marshes and maritime situations are: *Ruppia maritima, Triglochin maritima, Scirpus robustus, Juncus Gerardi, Salicornia herbacea, Tissa maritima, Aster subulatus, Senecio viscosus.* Analyses of the salt soils show saturated soils to contain solutions varying in concentration from .957 per cent to 7.32 per cent. A strongly saline sample of soil bearing *Tissa, Salicornia,* etc., yielded the following figures: 20 grams of fresh soil contained 6.56 grs. water (by evaporation to constant weight in laboratory at room temperature), .479 grs. water soluble salt, 2.489 grs. acid soluble material, 1.896 grs. volatile material and residual water, and 8.576 grs. solid residue after ignition.

Spermatogenesis and Behavior of Pollen Tube in Some of the Cucurbitaceæ. J. E. Kirkwood.

The forms studied were *Fevillia cordifolia, Melothria pendula, Cucurbita Pepo, Micrampelis lobata, Cyclanthera explodens.*

In the organogeny of the flower, the sepals, where present, arise first, followed by the petals on an inner circle and alternating with the outer members. Stamens appear about the same time as the petals, with which they alternate in *Fevillea.* The archesporial series of cells is hypodermal in the outer angles of the anthers and divides to furnish primary tapetal and primary sporogenous cells. In *Fevillea* the latter multiply by repeated divisions to form a mass of pollen-mother-cells. Cytoplasmic phenomena in the mitosis of the pollen-mother-cells of *Micrampelis* are interesting as revealing the evolution of certain darkly staining masses, which are regarded as the extranuclear nucleoli of other writers. These appear to arise, before the dissolution of the nuclear membrane, from kinoplasmic strands of the cytoplasm.

The pollen tube, in some of the forms examined, requires about forty-six hours to reach the embryo-sac. Its course is mostly intercellular. Where starch is present in the tube it was not found in the conducting tissue and where found in the conducting tissue none appeared in the tube. Evidence points to the secretion of peptones in the one case and of sugars in the others as the directive stimulant, and to the endosperm nucleus as the center for the elaboration of such stimulant in the embryo-sac.

Fasciation of Field Peas: F. H. Blodgett.

Carelessness in selecting seed often results in direct loss in the quality or quantity of a crop, but this loss is not always as distinctly evident as was recently the case in fields of peas grown for cannery purposes, near Baltimore. The peas in question were grown from seed secured through a feed dealer, who knew nothing apparently of their pedigree, and who could not guarantee the quality of the seed as the regular seedsmen do. The observations were made especially upon two fields of approximately fifteen acres from which no crop was harvested and probably not more than five per cent. of a crop formed. The lack of pedigree establishing good qualities on the part of seed parents was made evident in the growth of the peas early in the season.

The soil conditions were a light sandy loam abundantly enriched with city manure, upon which the large amount of moisture and high temperatures worked together to produce a very vigorous growth of vine, but which from its very vigor, was abnormal. The vine instead of setting pods became fasciated, forming tubular or flattened stems bearing large numbers of flowers at the upper end, which set practically no seed. The stems had the appearance of two tubes, the inner one tapering downward to a point and united to the upper cylindrical portion by the common rim, along which the flower clusters were developed. The two tubes were practically free from any connection with each other, except at the end and each bore upon its exposed surface leaves and branches, the inner one, of course, in a lesser degree. Many of these branches were hollow and often somewhat flattened or fasciated.

The cultural conditions in the locality are such that the pea vines are almost a complete loss in the absence of stock to which it could be fed, the only use possible being to turn them under as green manure. The loss to the grower was total and was measured by the cash outlay, not only for the seed in the first instance but for all labor upon the field, and the maintenance of the force of pickers, for a number of days in anticipation of a possible crop. Seed of known parentage will hereafter be used in the locality where the above observations were made.

F. E. LLOYD,
Secretary.

SCIENTIFIC BOOKS.

International Catalogue of Scientific Literature. First Annual Issue. N—Zoology. Part I., Author Catalogue. Part II., Subject Catalogue. London, Harrison & Sons. 1904. Pp. xvi + 1528.

This work is planned to include the zoological literature for the year 1901, although one is compelled to analyze the preface in order to determine the period covered, since no record of its extent appears on cover or title page of either part. According to information printed on the cover the manuscript of this volume was completed in August, 1903, and the printed copy is dated February, 1904, although the work seems not to have been generally distributed until some months later.

Part I. contains the general explanations with the scheme of classification and an index thereto in English; and this matter is repeated in French, German and Italian. Following these the author catalogue fills 260 pages and lists 5,918 titles. Part II., which is about three times as voluminous, contains at the close a list of journals with abbreviated titles and the topographical classification. More than 1,100 pages are filled with the subject references proper. The system used has been the subject of extended discussion in SCIENCE and calls for no further notice here. The addition to each phylum of a list of names of new genera and species will commend itself to all as a most desirable feature.

Such bibliographic work is not new in the zoological field, and several of the similar enterprises already in existence have achieved noteworthy success. The oldest of these is the *Zoological Record,* which is especially full along taxonomic lines, while the *Zoologischer Jahresbericht* manifests a confessed morphological bias. Both of these, but more especially the latter, include an analysis of the subject matter of publications cited, whereas the admirable literature lists of the *Zoologischer Anzeiger* only hint at the contents of a publication by its classification. The *Bibliographia Universalis* of the Concilium Bibliographicum forms a subject catalogue comparable directly with the publication under consideration. A comparison of this volume with the results achieved by the other agencies noted will constitute a fair test of its value to workers in zoology.

In respect to promptness in appearance the 'International Catalogue' is certainly at an abnormal disadvantage in the first year of its history; whether this is sufficient excuse for its publication from one to two years later than the same material was available through the other agencies will depend upon individual judgment. At least its belated appearance should enable it to equal the results of other bibliographies. A close approximation of titles listed gives over 6,600 for the *Zoological Record,* over 8,000 for the *Zoologischer Anzeiger* and over 8,400 for the *Concilium Bibliographicum* as against the 5,918 entries in author list of the 'International Catalogue.'

The character of the subject catalogue has been tested both topically and taxonomically. On the taxonomic side Professor Weltner, of

Berlin, has called attention in a recent article* to the treatment of the sponges, where only 27 papers are included out of 82 which appeared during the year 1901. Among those omitted are some of first importance, while even of the references given the entries under special headings are incomplete and erroneous. The reports on Porifera in the *Zoological Record* and in the *Archiv für Naturgeschichte* appeared in advance of the date given for the completion of this manuscript, and yet the latter is much less satisfactory.

He might also have added that the insufficiency of the work on Porifera goes to show governmental red tape in this enterprise and lack of real control on the part of the scientific staff, since, according to the title page, the very man stands sponsor for this volume who had already published one of the admirable bibliographies cited by Weltner as worthy of emulation.

Dr. T. Wayland Vaughan has published in Science† a comparison of the work on Cœlenterata here with the cards of the Concilium Bibliographicum, and the *Zoological Record*, He found that "the Concilium Bibliographicum procured 70 per cent. of the references, the *Zoological Record* for 1901, 63 per cent., and the 'International Catalogue' 40 per cent." "Works of importance published in practically every country are left out." Promptness in appearance was in inverse ratio to completeness.

A further analysis of the subject catalogue yielded interesting and important results for its evaluation. Under the heading 0020 'Periodicals, Reports of Institutions, Societies, Congresses, etc.,' are entered half a dozen reports of individual journeys, excerpted from publications of learned societies and certainly not appropriately classified in this subdivision, while at the same time the leading zoological journals are omitted. Furthermore, such journals as are concerned with single groups merely are entered here in some cases instead of under the fitting special heading, *e. g., Philadelphia, Pa., Students' Entomological Association,* or *International Congress of Ornithology in Paris, 1900.* In fact, the technical periodicals seem also to have fared ill in this catalogue for the leading ornithological and entomological journals do not appear in any of the lists.

* *Zool. Anzeiger*, July 26, 1904, Vol. 27, No. 25, p. 788.

† N. S., Vol. XIX., No. 492, p. 860.

Such inappropriate entries also occur among individual publications, *e. g.*, the *Sequence of Plumages & Moults* entered under general treatises, the *Reproduction of the Protozoa*, and *Entomological Field-work* cited under addresses. Open to even more serious criticism are such entries as a *Collective Investigation of Indian Culicidæ* and *Studies on Eocene Mammalia* under 0060 'Collections.' Under the same numeral the subheading 'Economics' is also inconsistently and very incompletely treated; but this is, no doubt, a difficult topic to limit precisely. The same can not be said, however, of 0070 'Nomenclature (Principles of)' in which important references are lacking, while 0090 'Technique' has a total of only 14 titles, some of which belong under microscopy or biology, whereas the real list of appropriate references under this heading can not be reduced to less than fifty or seventy-five titles, and the Concilium Bibliographicum gives 110 cards with the date 1901. It should also be noted that the titles given in the 'International Catalogue' have no claim at all to preeminent importance, for trivial items are included and weighty papers omitted. The analysis might be pursued with similar results through the other headings of the catalogue. It is evident that the work has not been done by persons at all familiar with the subject matter. This feature is strikingly shown in the omission of a paper on certain insects entitled, 'Encore quelques mots sur l'élevage des Bacilles,' although two other papers by the same author and in the same journal are duly cited. One can not help wondering whether the missing paper will turn up under botany or bacteriology!

In order to test the accuracy and completeness of the subject references for technical purposes, I chose as a topic the fauna of New Guinea and took for comparison the cards of the Concilium Bibliographicum under the same heading. There were 36 of these cards as against 8 references in the 'International Catalogue' and one title was lacking from the cards, whereas 29 were not entered in the 'International Catalogue.' A further study of the author catalogue in the latter showed that in reality but four titles were lacking and one other was incorrectly entered. Of the titles missing from the subject catalogue six were entered under more general headings, since the bibliographer had doubtless followed the error in the titles of the papers; two were entered incorrectly under other geographic divisions, and twenty-one were not listed under any faunistic subdivisions, although seven of these gave positive evidence and two others bore some indication in the title that this region was treated. An analysis of parthenogenesis made in the same way showed nine titles wanting from the 'International Catalogue,' and from the cards only two, both of which were Russian.

A similar test was made in the subject of parasites, where the publications are sufficiently numerous, the notes and references sufficiently hidden, and the places of publication so dispersed as to test very sharply the character of any bibliographic enterprise. Twenty-four references were lacking among the cards of the Concilium Bibliographicum, ninety-three from the subject lists of the 'International Catalogue'; and of these latter forty-eight bore distinct evidence in the title that they treated of parasites of specific groups of animals.

The list of names for new genera and species constitutes, as already noted, an important and most desirable feature of the 'Catalogue.' Here the method of entry is distinctly faulty in that the type is not noted, the locality is not given, the page of first record is not entered and the original form is not cited in connection with those designated as new names. On reviewing the parasitic forms I was able to find many names of new genera and species omitted, even from the papers listed; in all were noted as wanting among Protozoa two new genera and four new species; among flatworms one new genus and eighteen new species; among Nematoda two new genera and ten new species; among parasitic Crustacea two new genera and four new species. I do not doubt that the actual number wanting is decidedly greater than the figures given.

Some tests were also made to determine the accuracy of the work, both in citation and in the elaboration of the material used. In addition to such as are evident mistakes in printing, there is the usual number of errors of a purely mechanical type, such as reversing the names in a paper of joint authorship, entering papers by two authors of somewhat similar name under a single heading, or ascribing publications to a different author of the same family name. In some instances also papers are included which, according to other authorities, fall within 1900 or 1902. In the one instance, which could be checked here, the 'International Catalogue' is apparently in error. Even in work done by our own countrymen one finds the Washington Academy of Sciences referred to as the National Academy.

As regards accuracy in handling the material treated, I have to record without further comment the chance discovery that among the papers in the *Quarterly Journal of Microscopical Science* two in the March (1901) number are omitted and also two in the May (1901) number. A more extensive test could not be made for lack of time; yet missing titles were noted from several prominent journals.

A lack of uniformity in treatment is very noticeable in the work done by different nations. Thus the English bibliographers have entered chapters in text-books under special headings and also reviews of various articles. Had this been done by other nations it would have added largely. Very likely some such references should be included, and that when they contain valuable critical matter by some specialist on the group under consideration; but it is equally patent that only such a specialist can pass upon the value of such items. From the standpoint of a bibliographer the treatment of these matters must be uniform. The lack of uniformity is further shown by the inclusion of a single article on *Bacillus icteroides* which probably owed its selection to the occurrence in the title of the phrase 'cold-blooded animals.'

It would require undue space to demonstrate here what the individual observer can easily verify, namely, that there are characteristic differences in the method of treatment given the material by different national bureaus. Some have clearly over indexed, others have been as distinctly deficient. Among German references it was difficult to find errors in classification, while among those of some other nations they were all too frequent.

As a result of a most careful study of this work one is forced to conclude:

1. With respect to promptness, completeness and accuracy the results are distinctly inferior to those already achieved for zoology by several bibliographic agencies.

2. A subsidy for any one of the existing agencies equal to a fraction of the amount spent on this part of the 'International Catalogue' would yield much greater results in giving the investigator actual control of the literature in zoology.

3. The effort to construct a bibliography from materials furnished by numerous national bureaus will not result in the production of a consistent work.

4. A useful bibliography in this field can not be prepared by mere cataloguers, however expert they may be, and however great the means at their disposal for the prosecution of the work.

5. The contention of Weltner and others is abundantly justified that only the specialist in zoology can make a satisfactory analysis of zoological publications, and only he should be allowed to control such work.

6. It is most important to add to the mere record of titles a brief critical annotation regarding the subject matter of each paper. Additional subsidies should be devoted to the improvement of existing agencies rather than to the creation of new organizations.

Henry B. Ward.

University of Nebraska.

SCIENTIFIC JOURNALS AND ARTICLES.

The Museums Journal of Great Britain for December has an excellent article 'On Colors in Museums,' by Hans Dedekam, dealing at some length with the question of what are the best colors for backgrounds for various exhibits. The balance of the number is devoted to reviews and notes, and includes a good review of Dr. Meyer's recent memoir.

The contents of the January number of the *American Journal of Mathematics* is as follows:

'Some Properties of a Generalized Hypergeometric Function,' by F. H. Jackson.

'Relation between Real and Complex Groups with Respect to their Structure and Continuity,' by Dr. S. E. Slocum.

'Determination of all the Characteristic Subgroups of any Abelian Group,' by G. A. Miller.

'Collineations whose Characteristic Determinants have Linear Elementary Divisors with an Application to Quadratic Forms,' by A. B. Coble.

'Concerning Certain Elliptic Modular Functions of Square Rank,' by John A. Miller.

'Minors of Axi-symmetric Determinants,' by E. J. Nanson.

'On the Forms of Sextic Scrolls having a Rectilinear Directrix,' by Virgil Snyder.

SOCIETIES AND ACADEMIES.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

A regular meeting of the New York Section of the American Chemical Society was held at the Chemists' Club, Friday night, December 9. The following councilors were elected from the New York Section: Messrs. Leo Baekeland, F. D. Dodge, T. J. Parker, W. J. Schieffelin and Hugo Schweitzer.

The regular program of the evening was then taken up and the following papers presented:

The Art of Sizing Paper with Rosin Soaps. Martin L. Griffin.

The subject is introduced by some general considerations pertaining to sizing paper, but deals principally with the claims frequently made, that acid or free rosin sizes are most desired, and that it is the free rosin that is the effective sizing agent in paper.

The author has made a large number of experiments, sizing paper stock in different ways with different reagents, showing conclusively that this is not the case, that free rosin is a poor sizing agent, and that the base of the precipitating agent plays a very important part in sizing paper. Incidentally he shows that any reagent whose base is alkaline will not effectually size paper, no matter how completely the rosin may be precipitated in combination with it.

The Tensile Strength of Bronzes. Wilder D. Bancroft.

The tensile strength of the copper-tin bronzes containing more than 92 per cent. copper varies relatively little with the different heat treatments. With bronzes containing 75 to 92 per cent. copper the strength is much greater if the alloy is quenched from above 500° than if it is quenched from below 500°. The extreme effect is to be found with the 79 per cent. bronze, which has a tensile strength of over 70,000 pounds per square inch if quenched from low red heat and a strength of only about 30,000 pounds per square inch if quenched from 400°. Similar results were obtained with the ductility measurements, though the maximum ductility does not occur at the same concentration as the maximum strength. The bronze containing 90 per cent. copper gives a 40 per cent. elongation if quenched from 540°, and only a 10 per cent. elongation as cast. This work has been made possible by a grant from the Carnegie Institution.

The Production and Modern Uses of Carbonic Acid. John C. Minor, Jr.

The paper describes the causes leading to the development of the carbonic acid industry, taking up the different methods of production, viz., calcination, acid treatment of carbonate, fermentation, the coke process, and the method used at Saratoga Springs for securing CO_2 from the natural mineral waters there. The treatment of the gas after production and the cylinders for holding it under high pressure are discussed. Among the commercial uses for CO_2 described at some length are mentioned: the manufacture of carbonated beverages, the extinguishing of fires on shipboard, the drawing of beer, the use in breweries for replacing the secondary fermentation, refrigeration, the operation of block signals, and the extraction of logwood. The therapeutic uses of CO_2 are also indicated.

F. H. Pough,
Secretary.

THE TORREY BOTANICAL CLUB.

The regular meeting of the club was held December 13 at the College of Pharmacy, Dr. H. H. Rusby in the chair, eleven members present.

The first paper on the program was by Professor F. E. Lloyd, who spoke of the Desert Botanical Laboratory at Tucson, Ariz. He pointed out that there were four characteristic types of desert visible with great regularity from the car window westward from El Paso, as the train passed from mesa to hill country or *vice versa.*

The character plants of these four deserts, which are remarkably distinct and pure, are the *Yucca, Ephedra, Mesquite, Parkinsonia* and *Fouquieria* in abundance. Professor Lloyd spoke in some detail of the vegetation in the vicinity of Tucson, illustrating his remarks with numerous excellent photographs, including several good pictures of *Cereus giganteus* in bloom and in fruit.

It was remarked that the plants with motile leaves, such as *Cassia, Acacia* and *Parkinsonia,* all faced the sun at sunrise, but did not follow its course during the day. *Fouquieria* was described in detail, attention being called to its short-lived primary leaves and curious spines, which were cited as an example of direct metamorphosis, the rosettes of secondary leaves appearing in the axils of the latter.

The primary objeet of Professor Lloyd's stay at the laboratory was the determination of the relation between stomatal action and transpiration. Numerous experiments were made, the results of which are to be reported in detail later.

The second paper, by George V. Nash, was on the vegetation of Inagua. Mr. Nash recently spent four weeks in collecting there. Inagua includes a large and a small island located some sixty miles northeast of Cuba, and with a total area of between five and six hundred square miles of mostly low land, the highest point reaching only 132 feet above the sea.

The flora is poor, embracing some 350 or 400 species, the relatively numerous cacti in the genera *Opuntia*, *Cactus*, *Melocactus* and *Pilocereus* emphasizing the desert-like conditions prevailing on the islands. Five plant areas were differentiated: (1) That of the strand; (2) the scrub, where nearly all the endemic species of the islands have been found; (3) the white sand or white land, as it is called locally, characterized by a species of *Coccothrinax;* (4) the salinas, characterized by the shrub *Avicennia nitida* Jacq., and (5) the savannas, where *Conocarpus sericea* Forst. is the characteristic shrub and *Sporobolus virginicus* the common grass. In the numerous salt holes is found the only fern of the islands, *Acrostichum aureum*.

Excellent photographs were exhibited showing the dwarfing effect of the sharp winds of the southern coast, where the vegetation, elsewhere six or eight feet tall, is reduced to a foot or two in height and becomes widely spreading.

One of the results of Mr. Nash's trip was the extension of the range of *Pseudophœnix sargentii* about 350 miles to the southward; another the collection of a number of new species.

Numerous photographs, and specimens from each of the plant areas, illustrated the speakers' various points.

Edward W. Berry,
Secretary.

THE SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

The Science Club of Northwestern University held its regular monthly meeting Friday evening, January 6, 1905.

The program was furnished by the department of mathematics of the university, Dr. W. M. Strong, of Chicago, presenting a paper on 'Some Points of Interest in Mortality Tables.'

Floyd Field,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE EPIDIASCOPE.

To the Editor of Science: With reference to Professor Todd's query in the last issue of Science, 'Who saw the Epidiascope at St. Louis?' I am happy to say that the apparatus has recently been installed in the anatomical laboratory of Brown University, a much appreciated gift from physicians of Providence and other cities. I had an opportunity of seeing the epidiascope in operation at Jena in 1903 through the usual courtesy of the Carl Zeiss management.

In actual use in the laboratory it surpasses expectations both in respect to convenience in handling and to range of capabilities. Lantern slides or other transparent objects up to about twelve inches in diameter and microscopic slides are projected with good effect. The new feature which especially distinguishes the apparatus—the projection of opaque objects—is of course the most remarkable. In this as in other respects we find that the claims put forth in the prospectus are, indeed, very modest. The color, texture, motion and third dimension of objects are beautifully reproduced. Colored lithographs in bound periodicals or reprints may simply be placed upon the carrier of the machine while the book is held open with the hand, and the whole page appears with the colors and lines of the figures perfectly reproduced. It is a great advantage that the image is not reversed. A manuscript or page of text can be read from the screen directly. Original water color or oil paintings are reproduced altogether too faithfully, for the effect is that received when standing close to the picture. Insects of various kinds have been tried; they lose nothing in the reproduction. The metallic luster and iridescence of the beetles show better because of the brilliant light than when viewed directly. On the other hand, moths or butterflies with bright colors and soft texture appear with as much naturalness as do the beetles. Such natural objects of course do not suffer from the magnification of details. A small adder and a newt when placed on the carrier appear on the screen as a boa constrictor and a giant salamander. Embryos or dissected specimens in water or in alcohol give good images. A pithed frog, cut open, shows the beating of the heart and the peristaltic movements. Furthermore, the demonstrator can not only point to the parts on the object itself, but can further separate the organs with the forceps and each movement may be distinctly observed by all in the room.

It is obvious that the apparatus is of the highest value in demonstrating before an audience a great variety of solid or opaque objects which could not be shown by lantern slides even were the time and money for preparing them available.

A. D. Mead.
Anatomical Laboratory,
Brown University,
January 10, 1905.

QUOTATIONS.

ANOTHER CANCER SERUM.

The newspapers last week reported, with scare heads, photographs, photomicrographs, and editorial comments, a new cancer discovery from the Gratwick Pathological Laboratory at Buffalo. It is asserted that a number of cures of cancer in mice have been effected by means of a serum prepared at the laboratory and the hope is suggested that the treatment will be equally efficacious in man. According to the New York *Herald* the cancerous mice used for the experiments were obtained from Professor Jensen of Copenhagen. They survived the Atlantic voyage, but expired between here and Buffalo. The cadavera were preserved and inoculations from one of them 'took' on several live mice, and by repeated transplantation a large number of the animals with cancer became available for further experimentation. Many of these mice recovered spontaneously, and the experimenters conceived the idea that this fortunate result was brought about by the elaboration of an antitoxin. Having in mind the possibility of a successful serum treatment of cancer, they conducted a series of experiments which they think have proved beyond question that the blood of mice which have recovered from cancer possesses an antitoxic quality. This blood, when injected into mice suffering with cancer, arrested the growth, and when the tumors were not too large caused their disappearance.

We have no reason to doubt the accuracy of the observation of the workers at the Buffalo laboratory as regards the fact of the disappearance of the tumors in mice treated with serum, and we earnestly hope they may be able to develop their discovery so that it may become applicable to man. But the plans of mice and men are proverbially uncertain in their outcome, and it is deplorable that the secular press should have prematurely reported these incomplete results. Even if the highest hopes of the experimenters are eventually realized the announcement of their discovery at this time can but do much harm by inducing many present sufferers to cast away the plank of surgical excision to grasp at what is yet but the straw of serum therapy. Schmidt, Doyen, Adamkiewicz and others whose names we have forgotten have elaborated antitoxic cancer sera, and they have failed to cure. This, of course, is no argument against the possibility of the Buffalo serum being efficacious, but in a matter of such momentous importance to mankind it behooves one to proceed with extreme caution and not to ignore the lessons of the past and the present even while dreaming of a glorious future. Many mountains have been in labor at various times, but, alas, many little white mice have been born.—*New York Medical Record.*

SPECIAL ARTICLES.

A MODEL ILLUSTRATING HITTORF'S THEORY OF THE MIGRATION VELOCITIES OF IONS.

As an aid in explaining the conception of Hittorf* the model shown in Fig. 1 has been found so satisfactory that a brief description is here given in the hope that it may be of service to those teaching the mechanism of electrolysis.

Upon a base-board, 50 cm. × 7 cm., two upright supports, *FF* (3 cm. × 1 cm. — 15 cm.), are fastened. Through these supports pass two cylindrical wooden rods, *EE*, 6 mm. in diameter and 47 cm. long. Upon these

* *Pogg. Ann.*, 89, 177; 98, 1; 103, 1; 106, 337, 513.

rods are placed sixteen wooden balls, eight on each rod as shown in the sketch. Across the top of the supports is fastened the horizontal scale, *SS*. This scale is divided into sixteen equal parts, the value of each division being the same as the diameter of a ball, or 28 mm. Between the third and fourth divisions, and between the twelfth and thirteenth divisions are placed two light strips of wood as shown at *BB* and *CC*. From the eighth division to the base-board is stretched a vertical wire, *DD*, 1 mm. in diameter. The upper row of balls are painted black and are chosen to represent kations; the lower row are painted white and represent anions. The strip *BB* is painted black, representing the kathode, and the strip *CC* is painted white, representing the anode. The wire *DD* represents the trace of an imaginary plane of reference through the solution.

With this arrangement it is possible to demonstrate to a class Hittorf's theory as explained by Ostwald.*

To make its use clearer let us take a concrete case. Suppose the anion of the electrolyte to have a velocity twice as great as the velocity of the kation. Placing the balls as shown in Fig. 1 with the wire *DD* bisecting the two rows, we move the middle of the lower row, the anions, from division 8 to division 10. We then move the upper row from division 8 to division 7. We have thus imparted a velocity to the anions twice as great as that imparted to the kations. Now let three molecules discharge, the ions assuming the atomic or molecular condition. To represent this we move the three end ions beyond the electrodes *BB* and *CC*, when we have the condition represented in Fig. 2. It is obvious that the ratio of the kathode loss to the total number of molecules electrolyzed is 2:3, and the ratio of the anode loss to the total number of molecules electrolyzed is 1:3. These two values bear the same relation to each other as the velocities of anion and kation.

By varying the conditions it is possible to

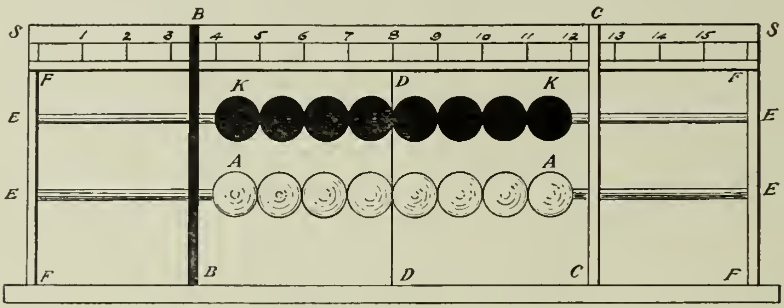

Fig. 1.

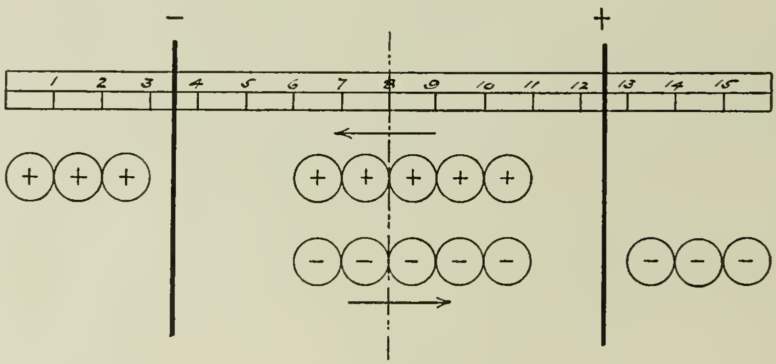

Fig. 2.

* 'Lehrb. d. Allg. Chem.,' II., 595.

illustrate in a very satisfactory manner the mode of ion transference.

Frederick H. Getman.
College of the City of New York.

*THE GEORGE WASHINGTON UNIVERSITY AND THE GEORGE WASHINGTON MEMORIAL ASSOCIATION.**

The annual meeting of the George Washington Memorial Association was held at Rauscher's on Wednesday, December 14. The president, Mrs. Archibald Hopkins, opened the meeting with an address recalling the events of the year, dwelling especially on the agreements of the association with the Columbian University, whereby the university changed its name from Columbian to the George Washington University and the association pledged itself to raise the sum of $500,000 to construct the central building of the proposed new university group in Van Ness Park. This building, the administration building of the university, was to receive the name of 'The George Washington Memorial Building.' The president laid stress upon the need in Washington of such a building, which should contain an auditorium for meetings of international tribunals and of scientific organizations.

The executive committees of the university and of the George Washington Memorial Association have already designated the architects who were to compete for the memorial building. The park commissioner, the committee for Greater Washington, Mr. McKim, Mr. St. Gaudens, Mr. Olmstead, and Mr. Burnam, with whom is associated Mr. Bernard R. Green, have consented to act as jury of award, and the date of the competition will be fixed as soon as the program, which was being prepared by Professor Percy Ash, of the university, should be finished and submitted to the jury.

The most vital problem, therefore, which the association had to solve was the raising of funds for the Memorial Building. Fifty thousand dollars were already in the possession of the association, and the association desired to raise fifty thousand more before March, 1905, so that the building could then proceed.

The president felt justified in saying that the outlook was most encouraging. The enthusiasm of California and of Utah had been rekindled by the recent visits of Dr. Needham; in Ohio and South Dakota interest was reviving, and Virginia, Maryland, Pennsylvania and New York were organizing meetings to be held in January and February. Meanwhile, literature was being prepared, plans carefully considered and state organizations perfected. All was as yet tentative; yet, in view of the work of the past year, the evident reawakening of interest, and the hearty cooperation of the George Washington University, the future of the George Washington Memorial Association seemed to be full of promise. The president then called upon Dr. Needham.

In his address Dr. Needham laid especial emphasis on the national and scientific character of the governing board of the George Washington University, and gave a brief sketch of the organization of the university, which had in view primarily graduate and professional studies, but grouped about this higher university work, as feeder to it, the organization provides for a number of independent colleges for undergraduate students, governed by their own distinctive boards. The first of those, Columbian College, which embraced all the undergraduate work now being done in the university, has now 401 students, this organization combining the essential features of the English idea, of Oxford and of Cambridge, with the American idea of a university.

Dr. Walcott congratulated the association upon the firm relations established during the past year with the George Washington University. Some fear, he continued, had been entertained that the Carnegie Institution, established for scientific research and for graduate work, would materially interfere with the prosperity of the university. This apprehension, however, had been removed, for, by the election of Dr. Woodward as its president, the Carnegie Institution definitely limited its sphere purely to scientific research. The committee on nominations having presented the names of the officers of 1903–04 for re-election,

* From the *Bulletin* of the University.

these officers were unanimously re-elected by the association for the year 1904–05.

PORTO RICO EXPERIMENT STATION.*

The work of the Porto Rico experiment station has been considerably enlarged during the past year, partly with the aid of an appropriation of $2,700 made by the insular legislature and nearly $1,200 received from the sale of farm products.

Many permanent improvements have been made on the station farm. A small tile machine was purchased and drain pipes were manufactured on the farm. Practically all the river bottom or alluvial land on the station farm has been drained. This is the first under-drainage ever undertaken in Porto Rico, and it is believed that it will not only greatly enhance the producing power of the station property, but will also serve as a valuable object lesson to the planters of the island. An experimental irrigation system has also been installed on this farm.

A preliminary survey of the principal tobacco districts of the island has been made by a tobacco specialist in the employ of the station, and a report on these investigations is being prepared.

The investigations on different methods of pruning, shading and fertilizing coffee plants have been continued. In an attempt to exterminate the coffee-leaf miner by hand picking the leaves proved the impracticability of this method of repressing this pest. The entomologist of the station has also been investigating the possibility of combating this insect by means of parasites, and reports the discovery of an effective parasite which, it is believed, by careful propagation and distribution, will aid very materially in keeping in check this insect, which is by far the most serious enemy to coffee cultivation now upon the island.

A special study of the diseases of coffee and other plants was made by the botanist of the Connecticut State experiment station, who was temporarily in the employ of the Porto Rico station.

* From the Report of the Secretary of Agriculture.

Much attention is being given to the propagation of citrous fruits, especially with a view of obtaining better stock for growing in the orchards of Porto Rico. A bulletin on the methods of production and marketing of oranges, with special reference to Porto Rico conditions, has recently been issued. A large number of tropical fruits, including mango, alligator pear, soursop, nispero, guava and many others, have been brought together in a tropical fruit orchard.

The tea, rubber and cacao plantations mentioned in my last report are flourishing and are being extended. Among the tropical vegetables which enter into the variety tests are the yautia, taro, edible canna, arrowroot, cassava, yams and sweet potatoes, all of which have thus far done well.

Experiments are being carried on with a number of fiber plants. Among these maguey and sisal have thus far given very promising results. The station has thus far conducted no careful experiments with cotton, but the industry has been extended throughout the island to a considerable extent during the past year, and the station officers report that the results seem to indicate that it is possible to profitably produce a medium grade of Sea Island cotton in Porto Rico.

The report of the Bureau of Soils on the soil survey from Arecibo to Ponce, made by that bureau in cooperation with the Porto Rico station, has been reprinted in both English and Spanish for distribution on the island. Several other bulletins and circulars in both languages have been issued during the year.

EIGHTEENTH SESSION OF THE MARINE BIOLOGICAL LABORATORY, 1905.

The eighteenth season of the Marine Biological Laboratory opens under favorable auspices. For the first time the laboratory is in a position to welcome investigators at any season of the year; a large stone building has been purchased and equipped with heating apparatus, running fresh and salt water, and the usual laboratory supplies. Two private rooms for investigators have been furnished in this building and are ready for occupancy. Mr. Gray, curator of the supply department, and two assistants are in residence throughout the year and are prepared to furnish material and supplies to investigators. Naturalists who wish to carry on research in the winter and spring at Woods Hole should apply for accommodations to the director of the Marine Biological Laboratory, Professor C. O. Whitman, or to the assistant director, Professor Frank R. Lillie, University of Chicago, Ill. The regular season for investigators opens in June when the summer laboratories will be ready for occupancy.

The Carnegie Institution has subscribed for twenty rooms for the season of 1905. Applicants for the use of these rooms should address the president of the Carnegie Institution, Washington, D. C., stating the general character of the work they propose to do, and the period for which the room is desired. Applications should be made as early as possible, as the rooms are generally all in use during July and August. Thirty-five other private rooms are reserved for investigators. Applications for these rooms should state the time of desired occupancy and any special needs, and should be sent to the director before May 1. All private rooms are supplied with reagents, glassware, etc., and carry with them the usual privileges in regard to supplies and aquaria and assistance in collecting material.

The regular session for students will begin on Wednesday, June 28, and will continue for six weeks. Courses in invertebrate zoology, in the life histories of marine animals, in physiology and in botany are offered. The annual announcement for 1905 will be ready on or before March 1, and may be procured from Professor Frank R. Lillie, the University of Chicago, Ill.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR RAPHAEL PUMPELLY was elected president of the Geological Society of America at the recent Philadelphia meeting.

THE officers of the American Anthropological Association for the ensuing year are: *President,* Professor Frederic W. Putnam, of Harvard University; *Secretary,* Mr. George Grant MacCurdy, of Yale University; *Treasurer,* Mr. B. T. B. Hyde, of New York; *Editor,* Mr. F. W. Hodge, of the Smithsonian Institution.

THE annual meeting of the National Geographic Society was held at Washington on January 13. Eight members of the board of managers were elected to serve for three years as follows: Alexander Graham Bell, Alfred H. Brooks, Henry Gannett, General A. W. Greely, Gilbert H. Grosvenor, Angelo Heilprin, O. H. Tittmann and General John M. Wilson. The report of the secretary, Hon. O. P. Austin, showed that the present membership of the society is 3,400, of whom 1,125 are residents of Washington and 2,275 distributed throughout the United States, Alaska, Philippines, Europe, Asia and Africa. The net gain in membership for 1904 was 789. During 1904 the society held twelve scientific meetings, sixteen special meetings, and four field meetings.

PROFESSOR E. WARBURG, director of the physical laboratory of the University of Berlin, has been appointed president of the Reichsanstalt.

DR. LIVINGSTON FARRAND, professor of anthropology at Columbia University, has been placed in charge of the work of the National Association for the Study and Prevention of Tuberculosis.

DR. MILTON J. GREENMAN, assistant director of the Wistar Institute of Anatomy and Biology of the University of Pennsylvania, has been elected director to succeed Dr. Horace Jayne.

THE Russian Geographical Society has conferred its Count Lüthe medal on Sir John Murray.

PROFESSOR WILLIAM H. BURR and Mr. William Barclay Parsons, members of the Isthmian Canal Commission, have sailed for Panama on the steamer *Orizaba.*

DR. CHARLES M. CHILD, of the department of zoology of the University of Chicago, is spending the winter quarter in research at Hopkins Seaside Laboratory of Stanford University, Pacific Grove, Cal., and at the San Diego Laboratory of the University of California.

Dr. G. R. Parkin has returned to superintend the election of Rhodes scholars for 1905 throughout the United States and Canada.

Professor Boyce and the members of the malarial expedition who left Liverpool for West Africa some time ago are returning on a steamer, which left Sierra Leone on January 8 for Liverpool.

Professor Friedrich Brauer, director of the Zoological Department of the Natural History Museum at Vienna, and Professor T. H. Fuchs, director of the Geological and Paleontological Department, have retired.

At a meeting of the Institution of Civil Engineers, on January 10, Sir William White gave an account of the visit paid to the United States and Canada by the institution last year during his term of office as president.

A conference on school hygiene has been arranged by the Royal Sanitary Institute to be held under the presidentship of Sir Arthur Rücker in the University of London from February 7 to 10.

Dr. Westbrook, of Minneapolis, was elected president of the American Public Health Association at the recent Havana meeting.

Dr. Hans H. Meyer, professor of pharmacology in the University of Vienna, has accepted an invitation to deliver the second course of Herter lectures at the Johns Hopkins Medical School next October.

Mr. Joseph Chamberlain will preside at the banquet of the Liverpool School of Tropical Medicine to be held on May 10.

Dr. L. Courvoisier, assistant in the observatory near Heidelberg, has been appointed observer in the Royal Observatory at Berlin.

The deaths are announced of Dr. Carl Otto Weber, an authority on the chemistry of india-rubber; of Mr. George H. Harris, an agent of the Division of Entomology, U. S. Department of Agriculture; of E. G. T. Lueder, a botanist, and of Professor Frank A. Leach, a teacher of science.

The deaths are reported of Dr. Anton Müttrich, professor of physics at the School of Forestry at Eberswalde, at the age of seventy-one years, and of Dr. Jacob Walz, professor of botany at Odessa, at the age of sixty-three years.

We learn from *Nature* of the deaths of Mr. G. W. Hemming, a mathematician, at the age of eighty-four years, and of Mr. Robert Harris Valpy, geologist, at the age of eighty-five years.

The French government has recommended an appropriation of $200,000 for the International Congress of Tuberculosis to be held shortly in Paris.

The third International Congress of Philosophy will be held at Heidelberg in 1908.

An International Association of Anatomists will be established at a meeting to be held at Geneva from August 7 to 10 of the present year. The initiative has been taken by the anatomists of the Swiss universities and has the support of the anatomical societies of Germany, Great Britain, France, Italy and America.

The German Astronomical Society offers a prize of 1,000 Marks for the most exact calculation of the next appearance of Halley's comet. The paper may be written in English and need not be presented until the end of the year 1908.

The Henry Saxon Snell prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the council of the Royal Sanitary Institute at intervals of three years, the funds being provided by the legacy left by the late Mr. Henry Saxon Snell. The first prize, which will consist of £50 and a medal of the institute, is offered in the year 1905 for an essay on 'Domestic sanitary appliances, with suggestions for their improvement.'

The U. S. Civil Service Commission announces examinations on January 30 for positions under the Isthmian Canal Commission, including those of assistant civil engineer at salaries of $200, $225 and $250 per month.

According to *Terrestrial Magnetism and Atmospheric Electricity*, the efforts of Professors Beattie and Morrison towards securing magnetic data in South Africa are receiving adequate recognition. The magnetic survey was originally started by them in the summer of 1897–8 at their own expense. Since then grants have been received from various sources and assistance has been rendered by various organizations and persons. The work has been zealously prosecuted so that there are now 362 stations distributed over Cape Colony, Transvaal, Orange River Colony, Natal and Rhodesia. There still remained, however, the northwest of Cape Colony and for the completion of this work the Cape government voted for the current year £200 and the Royal Society of London £250.

The library of the American Museum of Natural History has been given the private scientific library of Professor H. C. Bumpus, the director of the museum, amounting to more than three hundred volumes and twenty-seven hundred pamphlets. This collection is especially rich in works in comparative anatomy and brings to the library many valuable works and rare reprints not heretofore owned by the museum.

Medical papers state that with the advance of the cold weather, plague is again growing worse in Upper India. For the week ending December 3 the United Provinces had 4,425 deaths, an increase of 1,000 on the total of the previous week; the Punjaub, 2,446, an increase of 400; Mysore, 1,157, an increase of nearly 600; Hyderabad State, 768, an increase of 200. In the Bombay Presidency there were 6,770 deaths, an increase of 300. Elsewhere throughout India the disease remains about as before.

At Cornell University, January 17, before the conference or seminary of the department of neurology and vertebrate zoology, Mr. A. H. Wright, '04, gave an account of his collections and observations as to the fish fauna of Monroe County during the past two summers. Notwithstanding a previous survey, Mr. Wright has added eight species to the seventy-four already known from the Ontario basin, and thirty-two to the forty-two previously recorded for Munroe County. There was shown a combined table and diagram exhibiting, for a single creek eleven miles long, the varying conditions, mile by mile, as to the depth of the water, the contour and nature of the bottom, the rapidity of the current, and the range of the twenty-six species found in it. It appeared that in a given stream the lower, more sluggish and muddy portions are frequented by the larger and less active fish, while the smaller and more active live in the upper portions where the current is swifter and the bottom gravel or sand.

Mr. Morris K. Jesup, president of the Peary Arctic Club, by order of the board of directors, has issued the following appeal for funds to aid in the equipment of the new expedition which is to start under command of Commander Peary next summer:

There is an opportunity, offering strong probabilities of success, of securing for the country and this city, the honor and enduring fame of accomplishing a work of large and world-wide interest and value.

The Peary Arctic Club has been incorporated under the laws of the State of New York, for the purpose of aiding Commander Peary in his persistent efforts to complete the geographical conquest of the large unknown area of the North Polar basin, and secure for this country, if possible, the honor of attaining the extreme top of the earth.

The club has had subscribed, principally from its own membership, about $55,000, and, in order to avoid delay which would be fatal, has assumed the responsibility of contracting for, and is now building, a special ship of exceptional strength and powerful engines, to be completed about March 1, 1905.

This ship is the first ever constructed in this country for Arctic discovery.

Additional funds to the amount of $100,000 are necessary for the completion of the ship and equipment of the expedition, and it is not believed that the public-spirited men of means in this great country, and particularly this city, from which the expedition will start, will permit so broad and laudable an enterprise to fail for lack of so comparatively small an amount of money. The club cordially invites your cooperation in this enterprise, and hopes that you will contribute to the funds needed. Subscriptions for any amount will be gladly received.

Very respectfully,

Morris K. Jesup,
President Peary Arctic Club.

The American Forest Congress, which met at Washington from January 2 to 6, passed resolutions as follows: Urging on Congress and all legislative bodies full protection and preservation of the forest, especially protection from fire; advising reduction of taxation on lands held for forest reproduction, so as to induce forest conservation; urging the repeal of the timber and stone act; advising the guarded sale of timber growing on public lands; favoring in case of lieu land selections an exchange for lands of equivalent value or of similar condition of forest growth; advocating the immediate consolidation of all government forest work, including the administration of the National Forest Reserves, in the Department of Agriculture; favoring the passage of a law which will authorize the sale of all non-mineral products of the forest reserves, the proceeds to be applied to the management and protection of the reserves and to road and trail construction within them; that Congress appropriate adequate sums for the promotion of forest education and experiment work in all agricultural colleges and experiment stations in the United States; that opportunities be increased for general forest education in schools and colleges, and for professional training in post-graduate schools; urging the establishment of national forest reserves in the Southern Appalachians and in the White Mountains; that Congress declare forfeited all right-of-way permits not exercised promptly on issuance, and secure to all industries engaged in lawful business and which will promptly use their permits, the possession of necessary rights of way similar to those of railroads and irrigation companies, reasonable payment to be exacted for the use of rights of way on forest reserves and other public lands; that all state legislatures provide laws and financial aid to consolidate the rural schools in units sufficiently large that forestry, agriculture and home economics may be successfully taught by precept, example and practical work; and protesting against the attempted reduction of the area of the Minnesota National Forest Reserve.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Hiram W. Sibley, of Rochester, has given $5,000 to Hobart College.

By the will of the late W. H. Baldwin, Jr., Harvard University receives $2,000 and Tuskegee Normal Industrial Institute $1,000.

A Chinese viceroy has provided five scholarships for Chinese students at the University of California.

McGill University, Montreal, received during 1904 from a friend resident in the United States renewal of his donation of $400 for a fellowship in electricity.

The University of Missouri has issued a bulletin showing the growth of the university from December 31, 1890, to December 31, 1903. The statistical summary is as follows:

	1890.	1903.
Seminary fund (endowment)	$540,000	$1,240,000
From U. S. Government (yearly)	$29,150	$38,438
Annual income (for all purposes)	$122,255	$479,835
Buildings, books, and equipment	$360,000	$1,600,000
Students enrolled	510	1,649
Professors, Assistant Professors, and Instructors	38	100

Dr. James B. Angell, president of the University of Michigan, has presented his resignation to the regents of the university, but they have unanimously declined to accept it and offer to supply him with such assistance as he may need. Dr. Angell, celebrated his seventy-sixth birthday on January 7.

Dr. Paul L. Serrel has been appointed to an assistant professorship of mathematics at the College of the City of New York.

Professor G. Bodländer, of the Technological Institute of Brunswick, has been called to the chair of physical chemistry at Göttingen, vacant by the removal of Professor Nernst to Berlin.

Professor Joseph Partsch, professor of geography at Breslau, has been called to Leipzig.

Dr. Emil Wiechert has been promoted to a professorship of geophysics at Göttingen.

SCIENCE

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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 3, 1905.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE NATIONAL BUREAU OF STANDARDS AND ITS RELATION TO SCIENTIFIC AND TECHNICAL LABORATORIES.**

THE dedication of a large and well-appointed building to be devoted exclusively to instruction and research in physics is a notable event in the history of a college. In this instance it is the realization of a hope long cherished by many, and by none more than by the present speaker. That so splendid a building has been deemed necessary for the work to be done in physics suggests two things. First, the high standard which Wesleyan is setting for herself in this as in other departments of work, and, second, the rapid development which has occurred in recent years in physics, rendering imperative an equipment for experimental work of an entirely different order of magnitude from that thought sufficient a generation ago. So great has been the demand for the best instruments and standards to be used in experimental work, both in pure and in applied physics, that the government has been led to establish at Washington a national laboratory, one of whose functions is to cooperate with scientific and technical institutions and manufacturers in the work of improving instruments and standards and developing methods of measurement. It, therefore, seems not inappropriate that something be said on this occasion concerning this work of the national government, so recently in-

* An address delivered at the opening of the John Bell Scott Memorial Laboratory of Physical Science, at Wesleyan University, Middletown, Conn., December 7, 1904.

augurated as not to be generally known.

The bureau of standards was established by act of congress in response to a demand for such an institution on the part of many scientists, engineers, manufacturers and representatives of the national government. The high order of accuracy required in modern engineering practise and in scientific research made it more than ever necessary that manufacturers of scientific and engineering instruments should possess correct standards of length, mass and volume, as well as electrical, optical and thermometric standards, and be able to have them reverified from time to time. It was also important that any one engaged in scientific or engineering work could have his instruments and standards tested whenever necessary. The office of weights and measures, at Washington, had been equipped to do some of the work required in the verification of length, mass and volume for many years, but it was necessary to send electrical standards, thermometers and pyrometers and many other kinds of apparatus to Europe to be tested when results of the highest accuracy were desired. As this was both expensive and time consuming the consequence was that only infrequently were these more accurate tests obtained. The United States held a creditable position among the nations of the earth in physical science, and had some of the best physical laboratories in the world; it was leading the world in the manufacture of electrical machinery and some kinds of electrical instruments. To be obliged to ask the German imperial or other foreign laboratories to do our testing for us, because we lacked a well-equipped national laboratory for doing such work, was clearly a situation that ought to be corrected, and congress acted promptly when the importance of the matter was brought to its attention. Appropriations were made for laboratory buildings and equipment and for a director and a small scientific staff, and the bureau began its work July 1, 1901. President McKinley appointed as director Professor S. W. Stratton, of Chicago University, to whom more than to any one else is due the credit for the establishment and the success of the bureau. A careful study of the Physikalisch Technische Reichsanstalt and of other European laboratories was made in connection with the designing of the laboratory buildings and the selection of the equipment, and many valuable suggestions were derived therefrom. The laboratories have, however, been constructed after American rather than European models, although in their equipment it has been found necessary to draw very heavily upon European instrument makers.

The bureau began its work in temporary quarters and has been developing methods, building and acquiring apparatus and doing testing for the government and the public while the laboratory buildings have been under construction. The larger of the two buildings was only recently completed and the bureau is just now moving into it, the first building having been occupied nearly a year ago. We now find ourselves, about three and a half years from the organization of the bureau, in possession of buildings and equipment costing about $600,000, with a personnel carefully selected through the civil service and numbering altogether seventy-one, maintained by annual appropriations amounting to nearly $200,000, and, judged by the magnitude and importance of the output of testing and investigation, ranking second only to the great German Reichsanstalt among the government laboratories of the world doing this kind of work.

After this brief epitome of the history of the bureau let me state more particularly something of its work and of its relation to the scientific and technical laboratories of the country.

The work of the bureau may be briefly specified under three separate heads as follows:

1. To acquire and preserve standards of measure and to certify copies of the same, and to test and investigate measuring instruments and to determine the properties of materials.

2. To conduct researches and to investigate and develop methods of measurement; to improve instruments and apparatus for physical measurements and to devise new apparatus, especially for use in testing and in precise measurements.

3. To distribute information regarding instruments and standards to manufacturers, state and city sealers of weights and measures, scientific and technical laboratories, and to any and every one applying for such information.

These three functions of the bureau are closely interdependent. To acquire a standard in some cases involves an elaborate investigation and the independent determination of the value of the standard; and to preserve it may involve subsequent redeterminations of its value to ascertain whether any change has occurred. A new kind of test often involves the investigation of methods of measurement, or the determination of new standards or the construction of a new instrument. Thus research and testing are intimately connected in most of the work of the bureau.

The distribution of information, the third function of the bureau, is accomplished through correspondence and the circulars and bulletins issued by the bureau, and also by the personal visits of people seeking such information.

The three fundamental standards of measure are those of length, mass and time. The oldest of these is the unit of time, the second. This ancient unit has successfully withstood every attempt to replace it by a decimal submultiple of the day. The earth itself is our fundamental timepiece, every revolution upon its axis counting off 86,400 sidereal seconds, from which we immediately derive our standard second. No clock is so perfect a timepiece as the earth and all the standard clocks in the world are corrected by it. What the astronomer does in determining the time by astronomical observations, is to read off the time of day or night by means of a telescope on the starry face of the celestial clock. The telescope corresponds to the hour hand of a 24-hour dial (there is no minute hand), and the stars mark the subdivisions of the dial. The best made clocks of human invention go fast or slow by at least some fraction of a second each day, but there is no proof to show that the terrestrial clock deviates by so much in a thousand years. Thus the unit of time is a natural unit, easily obtained direct from nature and universally employed the world over.

The Bureau of Standards does not intend to make independent time observations, but will correct its standard clocks from the observations made at the neighboring Naval Observatory.

The unit of length has a very different history. The foot has been the most widely used measure of length, both in ancient and in modern times. It was derived, as the name suggests, from the length of the human foot and is thus a natural unit like the second; but, owing to the multiplicity of human feet and their varying dimensions, this unit has varied greatly in different countries and in different ages, its length ranging all the way from the ancient Welsh foot of nine inches to the Piedmont foot of twenty inches. In modern times it has varied from the Spanish foot of less than eleven inches to the Venice foot of over thirteen inches, almost every country using a foot of different length. The confusion resulting from this lack of uniformity prompted the French in 1799 to adopt a new unit of length, and remembering how surely and elegantly the unit of time is fixed by the rotation of the earth, they sought to make the meter, the new standard of length, permanent and inflexible by basing it upon the dimensions of the earth. The meter was chosen to be one ten-millionth part of the distance from the equator to the pole of the earth at a particular meridian, and was fixed in concrete form as the length of a platinum bar, which has been carefully preserved in Paris. Subsequent and more accurate measurements have given a slightly different value for the circumference of the earth, so that the meter is known not to be, as originally intended, just one ten-millionth of a particular quadrant of the earth. The meter has, however, not been changed, its value being fixed by the length of the platinum standard and not by the earth. Thus the platinum bar has become the primary standard of length, instead of a secondary standard as was originally intended. This is a happy result, for the difficulties of comparing a meter with the dimensions of the earth is too great to make the dimensions of the earth of any value as a standard of length. The original standard meter has been reproduced many times in platinum and iridio-platinum, and many of the civilized nations of the earth possess such duplicates. We have two of them at the bureau of standards in Washington, one of which was recently taken to Paris by Mr. Fischer, and recompared with the standards of the international bureau. The results showed almost perfect agreement with the comparison made fifteen years previously, the difference, if any, being not greater than about 0.5 of a micron, that is, 1/50,000 inch. This is one part in 2,000,000 of the length of the bar and represents about the limit of accuracy obtainable in comparisons of this nature, although the computed probable error of the observations was only .02 of one micron, or less than a millionth of an inch.

The third fundamental unit, that of mass, has likewise varied in different countries and in different ages. The most widely used unit was the pound, and before the metric system came into use there were hundreds of different pounds in use in Europe, differing from country to country and from province to province, and varying also according to the commodity to be measured. The ancient Roman pound was equivalent to a little less than twelve of our avoirdupois ounces, and from it were derived the various Italian pounds, varying in value from the Venice light pound, equivalent to about eleven of our avoirdupois ounces, and the Naples silk-pound and the Milan light pound of about twelve ounces to the Piedmont pound of about thirteen ounces and the Venice heavy pound of about seventeen ounces. There were silk pounds, and chocolate pounds, and table pounds, and goldsmith pounds and medicinal pounds; there were light pounds, and heavy pounds, and half-heavy pounds and extra-heavy pounds. There were pounds of 12, 14, 15, 16, 17, 18, 20, 21, 22, 24, 28, 30 and 36 ounces, and the ounces had varying values in different countries and in different provinces of the same country.

To remedy this distressing confusion the French, in 1799, at the same time the meter was chosen, adopted the kilogram as the unit of mass, fixing it concretely in a cylindrical mass of platinum, which was intended to be equal to the mass of a cubic decimeter of water at the temperature of its maximum density. This, like the meter, was designed to be a natural unit that could be derived originally at any subsequent time and in any country. But, as in the case of the meter, later determinations showed that the kilogram was not exactly equal to the mass of a cubic decimeter of water as was intended, and hence the platinum secondary standard was adopted as a primary standard of mass and no further attempt made to make it a natural unit. All other countries using the metric system use carefully constructed copies of this original kilogram as their standards of mass. The process of weighing is even more accurate than the comparison of lengths, so that the standard kilograms of the various countries of the world are practically perfect duplicates of the original and of each other.

In 1875 a conference of the representatives of seventeen nations was held in Paris and a permanent international bureau of weights and measures was established and is still maintained. It is located at Sèvres, near Paris, and is supported jointly by the participating nations. Its duties are to care for the fundamental standards of length and mass, to furnish accurately adjusted copies of the same, and to compare standards which may be returned from time to time. Some other testing is done, including the calibration of thermometers. The work is of the highest order of accuracy and leaves little to be desired so far as standards of length and mass are concerned. The metric system has been adopted by nearly all the civilized nations of the world, excepting Great Britain and her colonies and the United States, and is universally used throughout the world for scientific purposes. The electrical units are all based on the metric system and hence electrical engineers employ the metric system almost exclusively, even in this country. The gain to science and commerce due to the adoption of the metric system can scarcely be overestimated and it is to be hoped that it will soon be adopted by the English-speaking countries of the world.

The avoirdupois standard for the United States was defined in 1830 as 7000/5760 of the Troy standard pound of the mint, which in turn was a copy of the British Troy pound, derived from the standard of Queen Elizabeth made in 1588. The latter was derived from the standard of Edward III., and this is said to have come from the city of Troyes, France, hence the name, Troy pound. The metric system was legalized in the United States in 1866, and the meter was declared to be equivalent to 39.37 inches and the kilogram to 2.204 pounds. The international bureau began its work in 1879. The iridio-platinum prototypes of the metric standards were received in this country in 1889. These were so much superior as standards to the brass standard pound and the bronze yard, that in 1893 the metric standards were adopted as fundamental standards by the United States and the pound and yard were defined in terms of them. Thus the metric system is not only legalized in this country, but our fundamental standards are the meter and kilogram and all our weights and measures are derived from these metric standards using the legal equivalents.

Few people, perhaps, realize how needlessly complex our system of weights and measures really is. Instead of a single unit of weight and of length with multiples and submultiples having ratios of ten, and a unit of volume simply related to the unit of length, as is the case in the metric system, we have a multiplicity of units and all kinds of odd ratios for the multiples and submultiples. I beg your indulgence for a moment while I remind you of some of the absurdities of our system. But first recall how much simpler and more convenient our decimal coinage is than the English coinage. Nothing could be simpler than the expression of values in dollars and cents; the use of pounds, shillings and pence, to say nothing of guineas, crowns and farthings with their odd ratios, being cumbersome in comparison. But our weights and measures are far more cumbersome and complicated than the English coinage. We weigh most merchandise by avoirdupois weight, gold and silver by troy weight, medicines by apothecaries' weight, diamonds by diamond carat weight. We have dry quarts and liquid quarts, long tons and short tons, and a hundredweight is not 100, but 112 pounds. Coal is usually purchased at wholesale by the long ton and retailed by the short ton. A bushel sometimes means 2,150.4 cubic inches and sometimes it means a certain number of pounds weight of a commodity. The American bushel is derived from the old English Winchester bushel, but the legal English bushel of the present day is larger by 69 cubic inches. On the contrary, the English gallon is much larger than the American gallon, the difference amounting to about 20 per cent. We measure wood by the cord, stone by the perch, earth by the cubic yard. Moreover, among the different states of the union are considerable differences in custom and in legal equivalents. We are, of course, much better off than the countries of Europe were a century ago, but the difference is all too small.

Our medieval system of weights and measures is, however, too deeply rooted to be easily displaced. But the metric system is being used in this country more than is generally realized and our rapidly growing foreign trade is bringing it more than ever to the attention of merchants and manufacturers. In England a strong effort is being made to adopt the metric system, with the hope that ultimately a decimal system of currency may also be adopted. The English colonies are even more progressive than the mother country, and strong influences are at work to secure the decimal system throughout the British empire. It will be greatly to the advantage of the United States to keep abreast of this movement, and not to be the last among the civilized nations of the world to throw off the incubus of an incoherent system of weights and measures, whose chief claim lies in the fact that it is in general use.

The testing of lengths and masses constitutes one of the most important branches of the work of the bureau. As I have said, this work has been done by the government for many years, but the facilities for the work are being immensely improved by the bureau so as to extend the range and increase the accuracy of the work. The new laboratories will contain many new balances and comparators and every precaution is being taken to secure the most favorable conditions possible for precision work. When the installation is completed it will probably be the best of the kind in the world.

I have said that the three fundamental units of measure are those of length, mass and time, or the meter, kilogram and second. From these are systematically derived various other units, all forming what is often called the centimeter-gram-second system, or, more briefly, the c.g.s. system. It is not my purpose to enumerate the various derived units which are employed in scientific and technical work, but rather to describe briefly some of those employed in the testing and research work of the bureau. And first let me speak of the work in heat and thermometry. The testing of thermometers is one of the most important branches of the work of the bureau. This work is under the charge of Dr. Chas. W. Waidner, who is personally known to some of you. Dr. Waidner and his assistants have devoted a great deal of effort to the acquisition of reliable standard thermometers and to the investigation of instruments and methods. In this they have availed themselves of the results of the magnificent work that has been done in this field in Europe, more especially at the Bureau Internationale and the Reichsanstalt, and by the thermometer makers of France and Germany. For our present purpose thermometers may be conveniently grouped as follows: (1) Precision mercury thermometers, to be used as standards or for scientific purposes. They are calibrated very elaborately and are capable of high accuracy. (2) Ordinary mercury thermometers and clinical thermometers. We test clinical thermometers by the thousand and we hope before long that they will come to us by the tens of thousands. Clinical thermometers often change if graduated new, and hence they ought always to be aged, tested and certified to insure their accuracy. (3) High temperature mercury thermometers of hard glass, with nitrogen under pressure above the mercury column, reading up to 550° C. (or about 1000° F.). (4) Platinum resistance thermometers, thermocouples and other forms of pyrometers suitable for measuring furnace temperatures up to 1600° C. (about 2900° F.). Such instruments are used in many manufacturing processes, as well as in research problems and hence are found both in scientific and in technical laboratories. (5) Optical pyrometers for measuring the temperatures of the hottest furnaces and, approximately, even the temperature of the electric arc, the highest temperature attainable by any known means, namely, about 3950° C. (or 7150° F.). An investigation on this subject at the bureau has recently been published by Drs. Waidner and Burgess. (6) Low temperature thermometers, for temperatures below the freezing point of mercury, even down to the temperatures of liquid air and of liquid or solid hydrogen. Such thermometers use pentane or toluene; or a copper-constantan thermocouple is employed. For the very lowest temperatures helium gas is used, helium being the only gas not liquefied at the temperature of solid hydrogen, namely, about 16° above absolute zero, or 257° C. (or 430° F.) below the freezing point of water.

The bureau has done more or less testing in all these lines except the last, but hopes soon to add this to the list of tests which are made.

From the temperature of solid hydrogen to that of the electric arc is a wide range, indeed, and a very considerable equipment of apparatus and machinery is necessary to produce and to measure any temperature throughout this range. For the higher temperatures numerous gas and electric furnaces are required. For the lower temperatures a refrigerating plant and apparatus for liquefying carbon dioxide, air and hydrogen are required. The bureau has recently purchased the low temperature plant which was operated as an exhibit by the British government at the St. Louis Exposition. This was one of the most interesting exhibits of the entire world's fair. Liquid hydrogen was produced in larger quantity by this plant than had ever been done before, more being made and used in public demonstrations during the season than the total amount that has been produced since hydrogen was first liquefied. Solid hydrogen is also produced by the apparatus.

The optical work of the bureau is not so fully established as the work in weights and measures and heat and thermometry, but three well-trained specialists are devoting themselves to it and a fourth is soon to be appointed. The work of research and testing in this section, which has been taken up or is soon to be begun, includes the investigation of the optical properties of instruments and of materials; the application of interference and other optical methods to linear and angular measurements; the investigation of the spectra of vacuum tubes and other phenomena in connection with the passage of electricity through gases at reduced pressure; and the investigation of questions connected with the polariscopic analysis of sugar and the testing of polariscopes.

The latter subject is of special importance on account of the use of polariscopes in determining the duty on sugar imported into the United States. The bureau has undertaken, at the request of the Treasury Department, to supervise the work of polariscopic analysis of sugar in all the customhouses of the country. Sugar is the chief source of revenue among articles imported, the duties .collected by the government amounting to over $60,000,000 per annum. The duty on each importation is determined by the angle through which a beam of polarized light is rotated when passed through a solution of a sample of sugar, the percentage of pure sugar being shown by a specially prepared table when the angle of rotation has been determined. For some years a difference has existed between the experts of the government and those employed by the sugar interests as to the effect of temperature upon the indications of the polariscope, and although the difference is only a fraction of one per cent., it amounts to a large sum when applied to the hundreds of millions of dollars paid in duty during the last few years. The question is being contested in the courts and in the meantime the bureau is making some careful investigations on the subject in the interest of the government.

Another line of the bureau's work not yet fully established is the testing of gas and water meters, pressure gauges and manometers for high and low pressures, engine indicators and the determination of the strengths of materials including cements and other building materials. This will probably develop into a very important branch of our work, in which we can be of much service to scientific and technical laboratories, as well as to the government and the public.

The official testing of scales, measures of length and volume, gas, water and electricity meters and other instruments by which the commodities purchased by the people are measured is not done in this country as thoroughly as it ought to be. In very few cities do the sealers of weights and measures go about systematically testing the instruments employed for measuring merchandise. England surpasses us in looking after the interests of the people in this particular. One of the functions of the bureau is to educate the public to the importance of this work. A step in this direction is the national convention of sealers of weights and measures to meet next month in Washington in response to a call issued by the bureau of standards.

The various lines of testing and research which have so far been mentioned, namely, weights and measures, heat and thermometry, light and optical instruments, and engineering instruments, are included in the first division of the work of the bureau of standards. The second division includes electricity and photometry. In the early days of its development electricity was essentially a qualitative science; its modern history has seen it become distinctly quantitative, and its wonderful development has been largely, if not mainly, due to the use of measuring instruments in studying and applying it. The three fundamental units of measure are the ohm, the unit of resistance; the ampere, the unit of current; and the volt, the unit of electromotive force. These are so related by Ohm's law that when two are defined the third becomes fixed and can be determined by the use of the other two. These units are not arbitrarily chosen, but are determined by experimental investigation. Their magnitudes depend upon the fundamental units of length, mass and time, and these having been selected (namely, the centimeter, gram and second), the definitions or specifications of the electrical units follow logically, but their concrete expression in actual standards that can be employed in electrical measurements can only be attained after most painstaking researches in what are called absolute measurements. The two of these three units which have been so determined are the ohm and the ampere. As all other electrical units are based upon these, it is of the greatest importance that they be determined with the utmost exactness. At the International Electrical Congress at Chicago, in 1893, they were redefined in accordance with the results of the best determinations made up to that time. The ohm is specified in terms of the resistance of a column of mercury 106.3 cm. long, having a cross-section of one square millimeter; the ampere in terms of the quantity of pure silver it will deposit electrolytically per second from a solution; the volt in terms of the electromotive force of the standard Clark cell. An immense amount of work has been done by numerous investigators in various countries of the world in the determination of the values of these electrical units, and the figures adopted in the definitions undoubtedly come very near the truth. Nevertheless, we know from subsequent work that at least two of these units are very slightly in error, and one of the most important problems before the bureau of standards is the redetermination of these fundamental units. The error in question is small, so small as to be of no consequence in engineering and commercial work. But scientifically it is important, and as instruments and methods are improved year by year, any small discrepancies in our fundamental units become of more and more significance. The National Physical Laboratory of England, the Physikalisch-Technische Reichsanstalt of Germany and the National Bureau of Standards, as well as a few private investigators in this country and abroad, are all working in the same direction. The recent International Electrical Congress at St. Louis provided for the formation of an international commission, whose function it shall be to foster and in some degree direct and coordinate researches of this character. This commission will probably organize and enter upon its work during the coming year. The difficulties to be overcome are so great that only the most elaborate researches carried out under the most favorable circumstances can be expected to bring us appreciably nearer the desired goal. Two researches at the bureau of standards during the past year gave results of value preparatory to the redetermination of the ampere in absolute measure. One was by Dr. Wolff, showing how to overcome one of the defects of the standard cell; a new method of preparing the mercurous sulphate yielding a crystalline product which gives cells of more uniform electromotive force than formerly. Professor Carhart, of Ann Arbor, who has been engaged upon this subject for some time, arrived independently at the same result even earlier, the results being announced by both men at the same meeting in Washington in April last. The other investigation was by Dr. Guthe, who, after carefully studying all the various forms of silver voltameters which have been proposed, showed that although different kinds gave slightly different results, certain ones when properly handled, gave practically identical results, and hence could be depended upon for measuring current to a very high order of accuracy. Dr. Wolff is continuing his work on standard cells and Dr. Guthe is now engaged in the absolute measurement of current, by means of a new electrodynamometer.

I have been engaged, with the assistance of Mr. Grover, Dr. Lloyd and several other members of the bureau, in the absolute measurement of electric capacity and inductance and in the investigation of electrical measuring instruments, more especially for the precise measurement of alternating current, voltage and energy. These investigations have involved the construction of much new apparatus, as well as the thorough study of some well-known instruments. One of the practical problems in connection with the accurate measurement of capacity or inductance is the determination of the frequency of the interrupter or of the alternating current employed. This usually amounts to obtaining the speed of some kind of motor, often an electric motor. For some kinds of work, to be within one per cent. is considered sufficiently accurate. For other cases one tenth of one per cent. is none too good. In still others one hundredth of one per cent. is deemed necessary. In this work we sought to get the frequency to a thousandth part of one per cent. This required a very perfect control of the speed, and yet by attention to all the sources of disturbances, and by the use of a very sensitive indicator, the desired result was obtained and an important additional step taken in absolute measurements.

Many other interesting and important questions are being investigated, and work enough for years is already before us. These particular examples of the work at the bureau have been cited, not because I presume that you are especially interested in the problems themselves, but rather to illustrate the kind of research work we are doing.

The work of testing is being carried on at the same time. Resistance standards, current standards, standard cells, wheatstone bridges, potentiometers, magnetic instruments, current instruments, voltmeters, wattmeters, condensers, inductances and many other electrical instruments have come to us from manufacturers, universities, technical laboratories and departments of the national government. To be able to get reliable standards and to have instruments calibrated at a nominal cost is a boon to all careful experimentalists. Heretofore it has often happened that the burden of the work in a given investigation has been to calibrate the instruments employed, and often the facilities at command were insufficient to yield results of high accuracy. Within the last three years (that is, since the bureau has been testing instruments) there has been a marked improvement in the quality of some kinds of electrical instruments made in this country. It is now so easy to determine whether a resistance box guaranteed by the maker to be correct to one fiftieth of one per cent. fulfils the guarantee, that the maker is compelled to use correct standards and to adjust his resistances carefully in accordance with the same.

Probably the most interesting collection at the St. Louis Exposition from the standpoint of physical science was the magnificent exhibit of scientific instruments made by Germany. There was a time not so very long ago when France and England surpassed Germany in the production of scientific instruments. But the giant strides which Germany has made in the last twenty years has left other countries in the rear, and this wonderful progress has been largely due to the wise encouragement and assistance offered to instrument makers by the German government. This assistance has taken various forms, but the principal factor has probably been the work of the Reichsanstalt and the Normal Aichungs Kommission, the two government laboratories doing the work which the bureau of standards aims to do in the United States. They have set a high standard for scientific instruments, and have not only shown how defects could be corrected, but have developed the theory and the design of many new instruments. All this has occurred so recently that it is not generally known in the United States, and German instruments are not as largely used as they deserve to be. We hope that the next few years may witness a similar impetus in the production of scientific instruments in this country, and that the United States may come to hold the same enviable position with respect to scientific instruments in general that she now does with respect to tools and labor-saving machinery and to certain special classes of scientific instruments.

The advantage of having instruments and standards of high accuracy for engineering and research work is obvious and needs no proof. I wish, however, to point out the advantage of using such instruments as far as practicable for purposes of instruction, especially in the more advanced laboratory courses. If the apparatus is not accurately adjusted the careful student and, perhaps, his instructor as well, is prone to lose valuable time in trying to locate errors that are inherent in the apparatus, or in striving for a degree of accuracy which is unattainable with the instruments employed. On the other hand, when the apparatus is known not to be correct it is so easy to attribute to the instruments any discrepancies in the results that careless reading and hasty work may possibly be encouraged. It is a great delight to the real lover of quantitative experimental work, of whom a great many are to be found in almost any college class, to do a piece of work with precision instruments and obtain an accurate result, duly checked by proper variations of the experiment. The educational value of such work is certainly greater than when only roughly done; the pleasure derived is incomparably greater. It is by no means necessary that all the instruments of a laboratory be sent away to be tested. If only the laboratory possesses correct standards and suitable comparing apparatus, the calibration or adjustment of most of the other instruments furnishes excellent experimental work for the students and assistants of the laboratory.

Another important section of the work of the bureau is photometry. This is really optical rather than electrical, but owing to the fact that the chief work is with electric lamps and a very considerable electrical equipment is required, it is grouped with the electrical in our organization. The standards employed in photometric testing are less satisfactory than in most other branches of physical measurements. The quantity of light emitted by a given source is usually expressed in candle power; the ordinary incandescent electric lamp, being approximately equivalent to sixteen standard candles, is called a sixteen candle-power lamp. The candle as a standard of measure has passed out of vogue, but light is still expressed in candle power. Various sources of light have been proposed as standards, the Hefner lamp burning amyl-acetate, being most used as a primary standard. As working standards specially prepared incandescent lamps are generally used, and are quite satisfactory. Greater progress has been made in recent years in developing photometers and the auxiliary apparatus for comparing lamps than in perfecting a primary standard of illumination. Although the initial equipment of the bureau for this work is not yet complete, we have already done considerable testing, especially in rating lamps to be used as standards by manufacturers and others, and in testing lamps purchased by the various departments of the government. Millions of incandescent lamps are sold each year on carefully drawn specifications, and it is a matter of considerable importance to know whether the conditions of the contracts are met by the manufacturers.

In addition to the exhibit made by the bureau of standards in the government building at the St. Louis exposition, an electrical laboratory was equipped and maintained in the electricity building. This was done at the request of the exposition management, the object being twofold; first to exhibit a working electrical laboratory, and, second, to do electrical testing for the jury of awards, for the railway test commission, and other electrical interests at the fair. The laboratory building, which was within the palace of electricity, and extended along one of its walls for a distance of about 175 feet, was divided into six rooms. Notwithstanding the fact that it was a temporary structure the laboratory possessed many of the appointments of a permanent installation; and, although many disadvantages and limitations were experienced in doing scientific work amid such surroundings, we succeeded in doing a good deal of satisfactory work, including both research and testing. So complete a laboratory has never been installed in any previous world's fair, and it proved to be of considerable interest both to visitors and to those electrical interests which availed themselves of its facilities for testing instruments. A refrigerating machine, installed adjacent to the laboratory as an exhibit, furnished refrigeration for experimental purposes and also for controlling the temperature and reducing the humidity of the atmosphere within the laboratory. This proved not only a great convenience in doing experimental work, but also a comfort to the workers, and the cool office of the bureau was a favorite retreat for the electrical jury in the hottest days of the jury period.

The third division of the work of the bureau is the chemical division, in charge of Professor W. A. Noyes. The development of this work has waited on the completion of our laboratory buildings. The installation of the equipment of the chemical laboratory is, however, now in progress and chemical work will be well under way before the end of the present fiscal year. The work in chemistry will consist in part in cooperating in certain lines of physical research, and in part in serving the chemical interests of the country. This will be done partly by research and partly by testing.

The bureau has already done considerable testing of apparatus used in volumetric analysis. The American Chemical Society, through its committee, has been cooperating with the bureau in fixing the limits of tolerance for such apparatus and in defining the specifications to be followed by the manufacturers. Another committee of the American Chemical Society has proposed a plan whereby standards of purity of chemical reagents shall be set, after careful investigation of the subject, and specific labels selected to indicate definite degrees of purity of such reagents. The bureau of standards, according to this plan, is to cooperate with the society in securing conformity to these standards on the part of manufacturers. I will not undertake to give details of the proposition; the work is of great importance and promises to bring the bureau of standards into close relations with the manufacturing and analytical chemists of the country. Another subject in which the bureau has been invited to cooperate with the American Chemical Society is in the matter of securing uniformity in technical analyses. Too great discrepancies are found in the results obtained by different public and other chemists when analyzing portions of the same sample. This is largely due to the different methods of analysis.

It is proposed to investigate thoroughly the various methods employed, and to select certain of the best as standard, with the expectation that, using the best reagents, the results found by different analyses may be more concordant and more accurate. Other lines of research and testing are contemplated, and will be undertaken as the facilities permit.

The field of chemistry, as well as physics, has so expanded in recent years that the two now overlap over large areas. Indeed, it is often impossible to say that a given problem belongs to one or the other, the fact being that it pertains to both fields. Hence, the physicist frequently comes to the point where he needs the resources of a chemical laboratory to carry him through a problem supposed to be purely physical, and conversely the chemist, not only in electro-chemistry and physical chemistry, but in analytical chemistry as well, requires very many of the facilities of a well-equipped physical laboratory. Hence we have so planned our laboratories that all the facilities of the entire equipment may be brought into service on any problem, whether it originates on the physical side or on the chemical. This we believe will prove of great advantage to the work of the bureau.

There are three chemists in the chemical division at present and the number will be increased as the work develops.

It is the aim of the bureau not only to conduct investigations through its members, but also to afford facilities for research by others who may come as scientific guests. It often happens that a proposed investigation requires apparatus or other facilities not at the command of the person proposing the investigation, and no university can, perhaps, offer him the necessary facilities and assistance. The bureau of standards hopes to encourage investigation by providing such facilities and assistance, but can do so only to a limited degree until the laboratory space is increased by additional buildings. There are scores and perhaps hundreds of ambitious physicists, young and old, engaged in teaching in the colleges and technical schools of the country who are deterred from doing valuable research work by lack of facilities and assistance. It is believed that a generous policy of assistance through the bureau of standards will be greatly appreciated by such workers, and that the output of original research from America will be materially increased thereby. A summer's work under favorable circumstances might yield as much as a full year's effort under adverse conditions, and a year, enough to amply repay the sacrifice it might involve. But, as I have already said, the full realization of this plan lies in the future. For the present all our laboratory space is required to meet our own pressing needs, although we do have just now one scientific guest with us, about to begin some interesting investigations.

I have tried to show briefly some of the work which the bureau of standards is doing and is preparing to do, to fulfill its functions as the American National Physical Laboratory, using the word physical in a liberal sense, as its work includes both chemistry and engineering. The national government is doing a large amount of scientific work, through the various bureaus and departments. That money expended in this direction is well invested, the Department of Agriculture, the Coast and Geodetic Survey, the Geological Survey and other bureaus have already abundantly proved. Their function and ours is to contribute something to the advancement of human knowledge and to serve the public. We hope not only to be of service to scientific and technical laboratories in the various ways I have tried to explain, but also to serve in many ways the larger general public.

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

Edward B. Rosa.
National Bureau of Standards.

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

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

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

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

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

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

Press Secretary—Professor J. F. Hayford.

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

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

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

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

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

The portion of the paper relating to meteorological phenomena is essentially an extension of Professor Brückner's researches on the 35-year cycle of variation in terrestrial climates. Definite epochs have been assigned for the variations of the several meteorological elements and the results of Brückner have been supplemented by investigations of various minor meteorological relations and the prices of grain. The probable value of the period length is found to be 36.2 years, instead of 34.8 years, Brückner having used in calculating the latter value an extra oscillation in the sixteenth century, which should be regarded as a secondary variation. Brückner traced the cycle as far back as 1000 A. D. by means of historical accounts of several winters. Comparison of the epochs in different latitudes discloses an apparent retardation in low latitudes. This may indicate that the influence efficient in producing these variations is experienced mainly in high latitudes. Periods of excessive precipitation follow by about five years those of deficient temperature. These cold, wet periods are characterized by a more rapid atmospheric circulation and a lower average latitude of storm tracks. Investigation of grain prices in England from about 1265 shows variations in a cycle of 36 years, high prices corresponding with cold, wet periods.

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

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

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

Tables showing solar and meteorological epochs were exhibited.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$P_i^p = Q^q = 1,\ P_iP_j = P_jP_i,\ Q^{-1}P_iQ = P_i^{a^{x_i}} (x_1 = 1),$$
$$a^q \equiv 1 (\text{mod. } p).$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Laenas Gifford Weld,
Secretary.

*ALBATROSS EXPEDITION TO THE EASTERN PACIFIC.**

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

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

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

arrival there on the first of November I found her ready for sea, and on the second we left for Mariato Point to make a few additional trawl hauls in the region of the green sand. In both the hauls made off Mariato Point green sand was found, but not in the quantity obtained in 1891.

From Mariato Point we made a straight line of soundings towards Chatham Island in the Galapagos, intersecting the ring of soundings we made northeast of the islands in 1891. The deepest point of the line (1,900 fathoms) was found about 100 miles southwest of Mariato Point. The bottom then continued to show about 1,700 fathoms for nearly 200 miles and then shoaled very gradually to 1,418 fathoms about 80 miles from Chatham Island. From there it sloped quite rapidly, the 1,000-fathom line being not more than 60 miles from Chatham Island. We ran a short line south of Hood Island and found a somewhat steeper slope to that face of the Galapagos, reaching over 1,700 fathoms in a distance of less than 50 miles; the bottom then remained comparatively flat, attaining a depth of 2,000 fathoms about 100 miles further south. This depth we carried eastward on a line to Aguja Point; about half way the soundings had increased to over 2,200 fathoms, and remained at about that depth to within 60 miles of the coast, when the depth rapidly shoaled. From Aguja Point we ran a line of soundings to the southwest to a point about 675 miles west of Callao; on this line the depths gradually increased from 2,200 fathoms, 100 miles off the point, to nearly 2,500 fathoms. On running east to Callao the depth soon increased to about 2,600 fathoms, and at a distance of about 80 miles off Callao we dropped into the Milne-Edwards Deep and found a depth of over 3,200 fathoms. We spent a couple of days in developing this deep, making soundings of 1,490, 2,845, 458, 1,949, 2,338 and 3,120 fathoms; showing a great irregularity of the bottom within a comparatively limited area of less than sixty miles in diameter. Thus far all our soundings have been made with the Lucas sounding machine.

In the Panamic Basin to the northeast of the Galapagos we trawled only off Mariato Point, but we occupied ten stations with the tow nets, hauling both at the surface and at 300 fathoms, and vertically from that depth; we also continued this pelagic work at nearly all the stations (35) from the Galapagos to Callao.

When off Chatham Island we began to trawl, and used the tow nets regularly, occupying 20 stations. The nets were in charge of Mr. F. M. Chamberlain. The pelagic collections, as a whole, are remarkably rich. They are especially noteworthy for the great variety and number of pelagic fishes obtained inside the 300-fathom line at a considerable distance from shore, from 300 to 650 miles. Many of these fishes had been considered as true deep-sea fishes, to be obtained only in the trawl when dredging between 1,000 and 1,500 fathoms or more. On one occasion the tow net brought up from 300 fathoms, the depth being 1,752 fathoms, no less than 12 species of fishes; of some species of *Myctophum* we obtained 18 specimens, of another 37, of a third 45; in all nearly 150 specimens. On other occasions it was not uncommon to obtain 8 or 10 species, and from 50 to 100 specimens. Among the most interesting types obtained in the tow net I may mention as coming from less than 300 fathoms *Stylophthalmus* and *Dissomma,* both of which Chun considers as deep-sea fishes, found in depths of 600 to 4,000 meters; also a species of *Eurypharynx* obtained for the first time in the Pacific. *Stylophthalmus* I had also caught in the tow net in 1900, during the tropical Pacific expedition of the *Albatross,* in depths of less than 300 fathoms. In the lines we ran across the great northerly current which sweeps along the coasts of Peru and Chili and is deflected westward at the easterly corner of the Galapagos Islands, we obtained with the tow nets an unusually rich pelagic fauna at depths less than 300 fathoms. We collected a number of schizopods, among them many beautifully colored Gnatheuphausiæ, pelagic macrurans; huge, brilliant red copepods, as well as many other species of blue, gray, mottled and banded copepods. *Lucifer* and *Sergestes* were abundant in many of our hauls. Many species of amphipods were collected, hyperids without number, especially where the surface hauls were made among masses of Salpæ, which, on several occasions, formed a jelly of tunicates. Several species of Phronimæ also occurred constantly in the tow nets. Sagittæ were very numerous, a large orange species being noteworthy. Several species of *Tomopteris*, some of large size and brilliantly colored, violet or carmine with yellow flappers, and two species of pelagonemerteans, were taken. Two species of orange-colored ostracods were also common, one having a carapace with a long spiny appendage. We obtained several species of pelagic cephalopods, *Cranchia* and *Taonius* among them. Two species of *Doliolum* also occurred, but they were never as abundant as the Salpæ, two species of which often constituted the whole contents of the net.

In the surface and deeper tows we procured a number of acalephs. We have thus far collected more than 50 species of medusæ and siphonophores, many of which have been figured by Mr. Bigelow, differing from those of the 1891 expedition. Atollæ and other deep-sea medusæ were common within the 300-fathom line.

The Salpæ guts gave us, in addition to the finer tow nets, immense collections of radiolarians, diatoms and Dinoflagellata, many of which have been considered to live at great depth and upon the bottom. The number of diatoms found in this tropical region is most interesting. They have usually been considered as characteristic of more temperate and colder regions. On several occasions the surface waters were greatly discolored by their presence, and the extent of their influence on the bottom deposits is shown by the discovery of a number of localities where the bottom samples at depths from 1,490 to 2,845 fathoms in the track of the great Peruvian current formed a true infusorial earth.

The tow nets also contained many species of *Hyalea, Cymbulium, Styliolus, Cleodora, Tiedemannia, Clio* and the like. On one occasion the mass of the pelagic hauls consisted entirely of small brown copepods, the contents of the tow nets looking like sago soup. Another time Sagittæ, Salpæ, *Doliolum* and *Liriope*, all most transparent forms, formed the bulk of the tow net's catch. Still another time, *Firoloides* and *Carinaria* constituted the bulk of the haul. These catches, coming on successive days or interrupted with hauls of more than mediocre quality, show how hopeless it is at sea to make any quantitative analysis of the pelagic fauna and flora at any one station within the influence of such a great oceanic current as the Chili and Peruvian stream.

Hauls of the trawl made at the western extremity of our lines brought us within the area of the manganese nodules, with its radiolarian ooze mud, cetacean earbones and beaks of cephalopods; nothing could stand the damaging action of these nodules in grinding to pieces all the animal life the trawl may have obtained. Down to the depth of 2,200 fathoms or so the bottom was constituted of globigerina ooze, its character being more or less hidden when near the coast by the amount of detrital matter and terrigenous deposits which have drifted out to sea.

North of the Galapagos we found vegetable matter at nearly all the stations, and between the Galapagos and Callao such material was not uncommon in the trawl.

Beyond the line of 2,200 fathoms dead radiolarians became quite abundant on the bottom, as well as in the mud of the manganese nodules, though among the nodules it was not uncommon to find an occasional *Biloculina*. Many of the dead radiolarians obtained on the bottom Mr. Kofoid found in the guts of Salpæ swimming near the surface or within the 300-fathom line in the tow nets sent to that depth. The same is the case with many of the Dinoflagellata which have been considered as deep-sea types. In our tow nets from 300 fathoms we found very commonly *Tuscarora, Tuscarosa, Aulospira* and others. In depths of 300 fathoms to the surface the tow net was rich in Tintinnidæ, either dead or moribund Planktionellæ, and Dinoflagellata. Among the Dinoflagellata there were 10 species of *Ceratium*, 9 of Peridinidæ, *Goniaulix, Phalacrona, Pyrocystis, Cytterocyla, Undella* and *Dictiocystus*. On the surface *Planktionella sol* predominates, with *Asteromphalc, Bidolphia* and *Sunidia thalassothrix;* among the Dinoflagellata we obtained 12 species of *Ceratium*, 5 of *Peridinium* and 22 species of other Peridinidæ; among the Tintinnidæ were a number of Sticholonga; among the Acantheriæ were especially to be noticed *Acanthometra, Acanthostaurus, Amphilonche, Collozoum, Thalassicola*, a number of *Chirospira murrayana* and a few Challengeridæ.

Our trawls brought up from the bottom many interesting fishes, among which I may mention *Bathyterois, Ipnops*, and a few bat-fishes, all thus far described by Mr. Garman from the 1891 expedition. I may mention also a *Chimæra*, different from the Chili species. The fishes have been admirably cared for by Dr. J. C. Thompson, U. S. N.

Among the crustacea were *Lithodes, Munidopsis* and many macrurans, all well-known species of the 1891 expedition. We found a few mollusks and a few interesting genera of tubiculous annelids. Compared with the 1891 expedition, few starfishes and brittle stars were obtained, and still fewer sea urchins, only one species of *Aceste* and one of *Aerope*, a marked contrast to the numerous echini collected in the Panamic Basin in 1891. We obtained, however, a magnificent collection of holothurians, nearly every species occurring in the Panamic Basin being found in numbers in our track south of the Galapagos, in the wake of the great Chili-Peruvian current and at considerable depths. On one occasion, at station 4647, in 2,005 fathoms, we obtained no less than 16 species of holothurians, among them brilliantly colored *Benthodytes, Psychropotes, Scotoplanes, Euphronides* and the like. At station 4670, in 3,209 fathoms, we obtained 6 species of holothurians. At station 4672, in 2,845 fathoms, we also obtained very many specimens of three species of *Ankyroderma*, a large *Deima*, 2 species of *Scotoplanes*, 2 of *Psychropotes*, with a number of young stages of that genus; repeating thus the experience of the *Challenger*, which found holothurians in abundance at great depth, not only in the number of specimens, but also of the species, though the *Challenger* did not at any locality obtain as many as we did at station 4647. Mr. Westergren made a number of colored sketches of the species which were not obtained in the 1891 expedition. We also collected in the trawl a number of deep-sea actinians, none different, however, from genera found previously in the Panamic district. We also obtained a few pennatulids, gorgonians and antipathes, and a very considerable number of silicious sponges, usually associated with the holothurians found in deep water in the track of the Peruvian current. In the track of the current at not too great distances from the coast we invariably brought, even from very considerable depths, sticks and twigs and fragments of vegetable matter. On two occasions we brought up in the trawl specimens of *Octacnemus;* the trawl had been working at 2,235 and at 2,222 fathoms. Both Moseley and Herdman described this interesting ascidian as attached to the bottom by a small peduncle. While the presence of the peduncle can not be denied, yet its attachment, if attached at all, must be of the slightest, its transparent slightly translucent body, with its eight large lobes, suggesting rather a pelagic type than a sedentary form. This ascidian was discovered by the *Challenger* west of Valparaiso.

Mr. Chamberlain made two daily observations of the density of the water, and found the same discrepancies between our observations and those of 1891, with those given by the *Challenger* and in the German Atlas of the Pacific Ocean. Whenever we took a serial temperature, he also determined the density at 800 fathoms. We occupied six stations for the serial temperatures, two on the western termini of the lines normal to the coast across the great Peruvian current, two in the center of the current, and two at a moderate distance from the coast. These serials developed an unusually rapid fall in the temperature between the surface and 50 fathoms—nearly 12° at the western extremity of the northern line, the temperature having dropped from 71.7° at the surface to 59.2°. At 200 fathoms it was 51°, and at 600 fathoms it had dropped to 40.7°, the bottom temperature at 2,005 fathoms being 36.4°. The temperature of the station in the central part of the current in 2,235 fathoms agreed with the western series. At the eastern part of the line, in 2,222 fathoms, with a bottom temperature of 36.4°, the surface being only 67°, we found again a close agreement at 50 and 100 fathoms, the lower depths at 400 and 600 fathoms being from one to two degrees warmer than the outer temperatures. On taking a serial from the surface to 100 fathoms, we found that the greatest drop in temperature took place between 5 and 30 fathoms.

The temperatures of a line running due west from Callao showed a very close agreement both at the western end of the line, about 780 miles from the coast, and in the central part of the line, as well as in the shore station about 80 miles from the coast in 3,209 fathoms. The bottom temperature in nearly all the depths we sounded was 36°, a high temperature for that depth. I do not at present make any comparison with the serials taken in the Panamic district in 1891, but wait until we shall have completed our lines to the south and to the west.

We leave for Easter Island on the third of December, where we shall coal, and from there go to the Galapagos, and thence to Manga Reva and Acapulco, where we ought to arrive in the early days of March.

The changes made in the working apparatus of the *Albatross* under the superintendence of Lieutenant Franklin Swift, U. S. Navy, have proved most satisfactory. The alterations in the main drum and the device for preventing the piling of the wire on the surging drum and the accompanying shock, have greatly reduced the risk of breaking the wire rope when trawling at great depths. The wire rope has proved an excellent piece of workmanship, and has served admirably in the comparatively deep water in which most of our trawling has been done thus far. A new dredging boom has also been installed, and everything relating to the equipment of the *Albatross* has been carefully overhauled.

Lieut.-Commander L. M. Garrett has been indefatigable in his interest for the expedition; the officers and crew have been devoted to their work; and the members of the scientific staff have carried out most faithfully their duties of preparing and preserving the collections thus far made.

We hoped to be docked at Callao, but owing to the prolonged occupation of the dock by a disabled steamer and the uncertainty of its becoming free within reasonable time, we decided to proceed without further delay to Easter Island and continue the expedition as we are.

ALEXANDER AGASSIZ.

SCIENTIFIC BOOKS.

Rational Geometry. By GEORGE BRUCE HALSTED. New York and London, John Wiley and Sons. 1904. Pp. viii + 285.

For over two thousand years there has been only one authoritative text-book in geometry. 'No text-book,' says the British Association, 'that has yet been produced is fit to succeed Euclid in the position of authority!' There is, in fact, little improvement to be made in Euclid's work along the lines which he adopted, and among the multitude of modern text-books, each has fallen under the weight of criticism in proportion to its essential deviation from that ancient author.

This does not mean that Euclid is without defect, but starting from the discussion of his famous parallel postulate, the modern development has been in the direction of the extension of geometrical science, with the place of that author so definitely fixed that the system which he developed is called *Euclidean geometry,* to distinguish it from new developments. The defects of Euclid arise out of a new view of rigorous logic whose objections seem finely spun to the average practical man, but which are based upon sound thought. The key to this modern criticism is the doubt which the mind casts upon the reliability of the intuitions of our senses, and the tendency to make pure reason the court of last resort. Thus, the sense of point between points, the perception of greater and less and many other tacit assumptions of the geometrical diagram, are the vitiating elements on which modern criticism concentrates its objections.

As an evidence of the ease with which the senses can be made to deceive, take a triangle ABC, in which AC is slightly greater than BC. Erect a perpendicular to AB at its middle point to meet the bisector of the angle C in the point D. From D draw perpendiculars to AC, BC, meeting them respectively in the points E, F. Let the senses admit, as they readily will in a free-hand diagram, that E is between A and C, and F between B and C; then from the equal right triangles $AED = BFD$, $DEC = DFC$, we find $AE = BF$, $EC = FC$, and, by adding, $AC = BC$, whereas AC is in fact greater than BC.

Are we to take our eyes as evidence that one point lies between two other points, or how are we to establish that fact? This query alone lets in a flood of criticism on all established demonstrations. The aim of modern rational geometry is to pass from premise to conclusion solely by the force of reason. Points, lines and planes are the names of things which need not be physically conceived. The object is to deduce the conclusions which follow from certain assumed relations between these things, so that if the relations hold the conclusions follow, whatever these things may be. Space is the totality of these things; its properties are solely logical, and varied in character according to the assumed fundamental relations. Those assumed relations which develop space concepts that are apparently in accord with vision constitute the modern foundations of Euclidean space.

Mr. Halsted is the first to write an elementary text-book which adopts the modern view, and in this respect, his 'Rational Geometry' is epoch-making. It is based upon foundations which have been proposed by the German mathematician, Hilbert. In point of fact, the book contains numerous diagrams, and is not to be distinguished in this respect from ordinary text-books, but these are simply gratuitous and not necessary accompaniments of the argument, designed especially for elementary students whose minds would be unequal to the task of reveling in the domain of pure reason. Also, in opening the book at random, one does not recognize any great difference from an ordinary geometry. In other words, those assumed relations are adopted which lead to Euclidean geometry. In this respect the author is appealing to the attention of elementary schools, where no geometry other than the practical geometry of our world has a right to be taught.

The first chapter deals with the first group of assumptions, the assumptions of association. Thus, the first assumption is that *two distinct points determine a straight line.* This associates two things called points with a thing called a straight line, and is not a definition of the straight line. The definition of a straight line as the shortest distance between two points involves at once an unnamed assumption, the conception of distance, which is a product of our physical senses, whereas the rational development of geometry seeks the assumptions which underlie and are the foundations of our physical senses. In the higher court of pure reason, the testimony of our physical senses has been ruled out, not as utterly incompetent, but as not conforming to the legal requirements of the court. However, there is no objection to shortness in names, and a straight line is contracted into a *straight,* a segment of a straight line, to a *sect,* etc.

In the second chapter we find the second group of assumptions, the assumptions of betweenness, which develop this idea and the related idea of the arrangement of points. In the next chapter we have a third group, the assumptions of congruence. This chapter covers very nearly the ordinary ground, with respect to the congruence of angles and triangles, and all the theory of perpendiculars and parallels which does not depend upon Euclid's famous postulate. This postulate and its consequences are considered in chapter IV.

All the school propositions of both plane and solid geometry are eventually developed, although there is some displacement in the order of propositions, due to the method of development. Numerous exercises are appended at the end of chapters, which are numbered consecutively from 1 to 700.

Undoubtedly the enforcement upon logic of a blindness to all sense perceptions introduces some difficulties which the ordinary geometries seem to avoid, but as in the case of our conception of a blind justice, this has its compensation in the greater weight of her decisions. It seems as if the present text-book ought not to be above the heads of the average elementary students, and that it should serve to develop logical power as well as practical geometrical ideas. Doubtless, some progressive teachers will be found who will venture to give it a trial, and thus put it to the tests of experience. At least, the work will appear as a wholesome contrast to many elementary geometries which have been constructed on any fanciful plan of plausible logic, mainly with an eye to the chance of profit.

Arthur S. Hathaway.
Rose Polytechnic Institute.

A Treatise on the British Freshwater Algæ. By G. S. West, M.A., A.R.C.S., F.L.S. Cambridge, The University Press. 1904.

Certainly there is no book upon any phase of cryptogamic botany for which there has been so much need, and for which the demand, in recent years, has been so great, as one dealing comprehensively with the fresh-water algæ. It is nearly twenty years since any work of the kind has appeared in English, and whatever may have been said in favor of the works of Cooke and Wolle when they were published, there can be no question about their having been out of date for a long time. Indeed, the tremendous strides made in algology during the last ten years has made it difficult for any one but the specialists to keep informed regarding the physiology, phylogeny and morphology of this group, to say nothing of the new genera and species. Of the fresh-water algæ alone, approximately one fourth of the genera now recognized have been described since the appearance of Engler and Prantl's classification in 1890. Consequently, nearly all of the important literature upon the algæ has been in periodicals and separates, often difficult to obtain, the result being that the general student of botany has, of necessity, been many years behind in his ideas regarding this most important and interesting group of plants.

G. S. West is well known as a contributor to journals upon algological subjects, notably the Conjugateæ, and for many reasons the author of 'British Freshwater Algæ' is particularly well qualified to write such a book. One can not but regret, however, that he saw fit to confine himself to British species. A treatise of this kind, so long waited for, should be as complete as possible, and when one looks in vain for *Pleodorina, Platydorina* and many other important genera which fit in so perfectly with the forms previously described, it leaves this treatise upon the fresh-water algæ in an unsatisfactory condition that hardly seems necessary. The fact that none of the Temnogametaceæ or Pyxisporeæ have been found in Great Britain seems a poor reason for excluding a discussion of these important groups in a book by West. Perhaps it is ungrateful to criticize a book which contains so much more than any previous one of its kind, for not containing all upon the subject, but the satisfactory way in which the included forms have been discussed makes it the greater pity that the plan of publication or other considerations made it necessary to confine the scope of the book to the British forms alone.

A good general discussion of the methods of multiplication and reproduction in algæ, together with a reference to the question of polymorphism and a rather full exposition of the particular theories of the author regarding phylogeny, precedes the specific treatment of the six classes, Rhodophyceæ, Phæophyceæ, Chlorophyceæ, Heterokonteæ, Bacillarieæ and Myxophyceæ. These classes, with their included genera, constitute an arrangement very different from that found in the average textbook or even in more pretentious publications, and offers a wide field for discussion. While in the main following the suggestions of Borzi, Blackman, Bohlin and others, there are certain divergences for which there does not always seem to be justification. On the other hand, long experience with certain groups has enabled Professor West to adopt what seems to be a more natural and satisfactory disposition of some forms than that followed by either Bohlin or Blackman and Tansley. On the whole, the classification is based upon the results of careful observations of the plants themselves, rather than a mere theoretical arrangement. Whether the author is justified, by the evidence at hand, in including the rather heterogeneous Syngeneticæ under the Phæophyceæ, or whether the Conjugateæ may not after all be regarded as a unicellular order which has come from the Volvocaceæ, with other disputed points, will probably require more facts before they can hope to be definitely settled. Nevertheless, it would be difficult to produce a system of classification which in the present state of our knowledge would be more satisfactory to a large number and at the same time recognize at least most of the investigations of recent years calculated to throw light upon the subject.

Attempts to revise the nomenclature for the purpose of putting the names of the principal genera upon a more stable and satisfactory basis have been made, not always, however, with success. That is, the rules adopted at one place seem to have been disregarded in another, resulting in a lack of consistency which can not but weaken any attempt to modify the names of well-established genera and species.

The book is fully illustrated and too much can not be said for the successful effort to secure new and accurate drawings of not only the more recently described genera, but for the older forms as well. It certainly is refreshing to be able to look through a book of this kind without seeing all of the old cuts of algæ that have done service since there began to be any literature upon the subject.

The need for a treatise upon the fresh-water algæ has been referred to; that this book will come as near to filling such a need as one of its scope, written by one man, could possibly be expected, is all that is necessary to say regarding its worth.

George T. Moore.
Bureau of Plant Industry.

SCIENTIFIC JOURNALS AND ARTICLES.

The December number (volume 11, number 3) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the October Meeting of the

American Mathematical Society, by F. N. Cole; 'The Fundamental Conceptions and Methods of Mathematics,' by Maxime Bôcher; 'The History of Mathematics in the Nineteenth Century,' by James Pierpont; 'De Séguier's Theory of Abstract Groups' (Review of de Séguier's Eléments de la Théorie des Groupes Abstraits), by L. E. Dickson; Shorter Notices (Cajori's Introduction to the Modern Theory of Equations, by L. E. Dickson; Annuaire Astronomique pour 1905, by E. W. Brown); Notes; New Publications. The January number of the *Bulletin* contains the following articles: 'The Group of a Tactical Configuration,' by L. E. Dickson; 'Application of the Theory of Continuous Groups to a Certain Differential Equation,' by J. E. Wright; 'On the Quintic Scroll having a Tacnodal or Oscnodal Conic,' by Virgil Snyder; 'On the Deformation of Surfaces of Translation,' by Burke Smith; Report of the International Congress of Mathematicians at Heidelberg, by H. W. Tyler; Report of the Sectional Meetings of the Heidelberg Congress, by E. B. Wilson; Notes; New Publications.

The contents of the December issue of the *Journal of Terrestrial Magnetism and Atmospheric Electricity* are as follows:

Portrait of Ettrick W. Creak, Frontispiece.

F. Bidlingmaier: 'Ueber den Einfluss der Torsion bei den Ablenkungen eines hängenden Magneten.'

L. A. Bauer and G. W. Littlehales: 'Proposed Magnetic Survey of the North Pacific Ocean by the Carnegie Institution.'

W. Sutherland: 'On the Cause of the Earth's Magnetism and Gravitation.'

L. A. Bauer: 'The Physical Decomposition of the Earth's Permanent Magnetic Field. No. V.: Systems of Magnetic Forces Causing the Secular Variation of the Uniform Portion of the Earth's Magnetism.'

Biographical Sketch of Ettrick W. Creak.

Letters to Editor: Interruptions to Telegraph Lines in New South Wales, Australia, as observed from the Chief Office (Sydney), on October 31, 1903, O. J. Klotz; Principal Magnetic Disturbances recorded at Cheltenham Magnetic Observatory, Sept. 1 to Nov. 30, 1904, W. F. Wallis; Some Observations of the Diurnal Variation of the Magnetic Declination at Cuajimalpa, Mexico, M. Morenoy Anda.

Notes, Abstracts, Reviews, and list of recent publications.

The Journal of Infectious Diseases (Volume 2, No. 1) contains the following articles:

David J. Levy: 'Some Physical Properties of Enzymes.'

Maximilian Herzog: 'Fatal Infection by a Hitherto Undescribed Chromogenic Bacterium, Bacillus Aureus Fœtidus.'

E. O. Jordan and Mary Hefferan: 'Observations on the Bionomics of Anopheles.'

George H. Weaver, R. M. Tunnicliff, P. G. Heinemann, May Michael: 'Summer Diarrhœa in Infants.'

Albert Woelfel: 'Identification of Alcohol-Soluble Hemolysins in Blood Serum.'

Richard P. Strong: 'Protective Inoculation against Asiatic Cholera.'

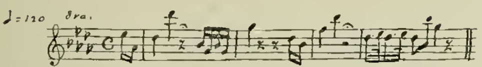
L. Hektoen and G. F. Ruediger: 'Studies in Phagocytosis.'

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 392d regular meeting was held December 5, 1904. G. K. Gilbert spoke briefly of observations of the marks of the claws of bears and other animals upon the bark of the aspen in the Sierra Nevada Mountains of California. Photographs of the trunks of trees so marked and specimens of the bark were exhibited.

Henry Oldys, under the title 'Some New Bird Songs,' gave an account of interesting songs noted by him in the spring of 1904. Most of these offered additional evidence of the use by birds of rules of construction that govern human music. The speaker reproduced, among others, several chewink songs, all of which were sung by one chewink. Two songs of a wood thrush, which were given, the speaker declared the most remarkable songs he had heard in years of experience. Each followed a form common in the modern four-line ballad and each was a model of melody. Hitherto, this four-phrase form had been found only in the morning and evening song of the wood pewee and in the usual song of the summer tanager, and neither had the melodic beauty that characterized the two wood thrush songs. These are of such interest as to be worthy of reproduction as follows:



William H. Dall read an abstract of the results of the study of the non-marine mollusk fauna of Alaska and the adjacent parts of Asia and North America, in which the relations of the east Siberian fauna to that of Europe, China and Japan; and of the Hudson Bay territorial fauna to that of eastern Canada, the Mississippi Valley and the Pacific slope were shown, and those of all the foregoing to the fauna of Alaska as at present known. He regarded the probability of many new forms being found in these regions as very small, for though still very imperfectly explored, the conditions on the whole are very uniform, and in some portions of the area quite thorough collecting has been done.

B. W. Evermann spoke of 'A Trip to Mount Whitney,' giving account of personal experiences while on a trip with the pack train into the region of Mount Whitney, California, in search of the golden trout of Volcano Creek.

The 393d regular meeting was held December 17, 1904. Dr. E. L. Greene spoke on 'The Earliest Book of Systematic Botany,' discussing the absence of everything approaching a natural classification of plants in ancient and mediæval botanical works, following with a statement of the principles first enunciated by the Italian Cæsalpinus in his book 'De Plantis' (1583), that plants and trees admit of a natural arrangement by considering the characteristics of their fruit and seeds; thus inaugurating the era of systematic botany. A cursory review of this book was given and statements made of that imperfect, though in general very natural sequence of genera which it exhibits.

A. B. Baker spoke briefly of 'Animals Recently Received at the National Zoological Park from Abyssinia and South America.' Among those mentioned were the animals received through President Roosevelt, to whom they were presented by King Menelek, of Abyssinia. Most interesting of these are the Somali ostrich, probably the only one of its kind in this country; the Grevy zebra, perhaps the handsomest of zebras; and two peculiar gelada baboons. He also spoke of animals received from South America through the U. S. Consul at Asuncion and by exchange with the Zoological Garden of Buenos Aires. These included a jaguar, guanacos, peccaries, capybaras, rheas, tinamous and a crested screamer.

Dr. Hugh M. Smith gave an account of the Japanese ayu or sweet-fish (*Plecoglossus altivelis*), which in some respects is one of the most remarkable of fishes. It is one of the Salmonidæ, but differs markedly from the salmons and trouts, and has been made the basis of a separate subfamily by Dr. Theodore Gill. The ayu is an annual fish, the entire cycle of its life from the egg to its death covering not more than a year. In dying after once spawning, it resembles the Pacific salmons. The eggs, laid in fall in rivers, are attached to stones, and hatch in a much shorter time than those of any other member of the family. The migrations are very peculiar, embodying a combination of anadromous and catadromous which is unparalleled; strictly speaking, however, the fish is neither anadromous nor catadromous, for it does not ascend the streams to spawn, and when it runs down the streams to spawn it does not go to sea. When young the ayu subsists on animal food, but after entering fresh water it feeds almost exclusively on algæ, which it scrapes from stones in mountain streams by means of curious chitinous papillæ which develop on the lips. The method of catching the ayu with trained cormorants was described and illustrated by lantern slides.

Wilfred H. Osgood,
Secretary.

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

The meeting of January 9, 1905, was called to order by the chairman, Dr. E. O. Hovey;

twenty-eight persons present. The minutes of the last meeting were read and approved.

Dr. George F. Kunz read a paper on the 'Jagersfontein or Excelsior-Tiffany Diamond,' the largest diamond ever found up to the present time. It weighed 970 carats, and was a gem of most marvelous purity. This diamond was most expertly cleaved into pieces, and from it were cut ten gems weighing from 13 to 68 carats each; a total of 340 carats; and these were imported into the United States. Mr. Kunz also stated that carbon silicide had been detected in the meteorite from the Cañon Diablo by Dr. Henri Moissan, of Paris, together with transparent diamond and black diamond. As carbon silicide has been made artificially with the electric furnace by Messrs. Cowles, Acheson and Moissan heretofore, and was first determined in nature by Professor Moissan, if agreeable to Professor Moissan, he would suggest the name *moissanite* for this compound.

The paper was illustrated by models and photographs. It was discussed by Professors Kemp and Stevenson, the chairman, and others. Brief replies were made by Dr. Kunz.

Professor J. J. Stevenson read a paper entitled, 'Recent Advances in our Knowledge of the Composition of Coals.' He said that the coals of Spitzbergen, according to Nathorst, are in great part of Jurassic age. The mining operations are confined to Advent Bay, a branch of the ice fiord of West Spitzbergen, where coal has been opened on both sides of the bay. The deposit has been followed northwardly for about ten miles, and for an equal distance westwardly.

The chief enterprise is on the easterly side of the bay, where the bed is somewhat less than five feet thick. The coal from the upper part is splint-like, while that from the lower part is brilliant and somewhat prismatic. The divisions show a notable difference in the percentage of volatile, the upper containing about ten per cent. more than the lower. The coal shows no tendency to coke, and that from the lower portion is attacked energetically by caustic potash.

The coal was compared with that from other localities in which the benches show notable difference in volatile. The results of tests with caustic potash made upon a number of coals appeared to show that non-coking coals are attacked promptly, while coals yielding a firm coke are not affected even after prolonged boiling. The speaker promised to give at a future meeting the results of an extended series of tests.

The paper was discussed by Professor Kemp and others.

The last speaker was Professor J. F. Kemp, upon 'New Sources of the Supply of Iron Ores.' Emphasis was first placed upon the enormous demands made by the iron industry of to-day upon the mines of the United States, Great Britain and Germany. The conviction was held by many that within fifty years the local American sources of rich ores of whose existence we now know would be exhausted and the iron masters would be compelled to seek new deposits. The following possible new districts were passed in review: the Labrador prospects discovered by Mr. A. P. Low, of the Canadian Geological Survey, which might also ship to Europe; Adirondack areas of reported magnetic attraction and possible lean ores, the Temagami district and the Michipicoten range, Ontario; the southern continuation of the Marquette range beneath the drift; the southern half of the Mesabi probable syncline beneath the swamps northwest of Duluth, as suggested by C. P. Berkey; the Baraboo range; the deposits in Iron County, Utah, and in the Wasatch Mountains; the magnetites of southern California and the prospects in Washington and along the coast. The speaker emphasized the important reserves in the titaniferous magnetites and their great quantity.

Passing to Europe the new developments in Sweden at Gellivara and Kirunavaara were reviewed and the possibilities at Routivaara; also the Dundeland valley in Norway and the similar deposits farther north. Their relations to the smelting centers in Great Britain and Germany were explained and their comparative amount with the 'minette' ores of France, Luxemburg, and Germany brought out. Other deposits in Spain, Algiers, Venezuela, India, Australia and Shan-si in China were mentioned.

The necessary connection between the coal fields and any great development of the iron and steel industry was emphasized and the future of the three great producers of to-day forecast as involved in the permanency of the coals. The reserves of coal are greater in Germany and America than in Great Britain. The province of Shan-si, China, having rich stores of both coal and iron, seems to be the one possible new location of the future great iron industry.

After a lengthy discussion, the meeting adjourned.

A. W. Grabau,
Secretary.

Columbia University,
New York City.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The third regular meeting of the club for the year 1904–5 was held on December 13 at 7:30 p.m. in the physical lecture room of science hall. The lecture of the evening was delivered by Professor B. W. Snow, head of the department of physics of the university, on the subject, 'Electrons, Radio-activity, and the Electrical Theory of Matter.'

F. W. Woll,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A BIOLOGICAL STATION IN GREENLAND.

To the Editor of Science: The establishment during recent years of biological stations in various parts of the world has proved to be of the greatest importance in furthering the progress of science. The great station of Naples has now a worthy competitor at Wood's Hole, and the botanical laboratory at Buitenzorg is aptly represented in this country by the Carnegie Desert Laboratory. The already large number of lesser institutions of similar nature is rapidly increasing, both in this country and abroad, and all add to the opportunities available for the working biologist.

Up to the present time the foundation of such stations has been confined, however, to regions with temperate or tropical climate, and no attempt has been made to establish a permanent station for biological research within the Arctic, until recently. A Danish botanist, Morten P. Porsild, has proposed to his government the appropriation of funds for such a station, to be located on the southern coast of Disko Island in North Greenland, not far from the colony Godhavn (lat. 69° 15′ N.). The proposal is well worth the attention and support of American scientists, and I shall here briefly review Mr. Porsild's plan, according to information supplied by himself.

Danish naturalists have, during the last twenty-five years, systematically explored Greenland; more than fifty scientific expeditions have been sent to that country, and the results are comprised in a series of about thirty volumes ('Meddelelser om Grönland'). It is with pardonable pride Mr. Porsild points to the fact that this has been accomplished at a cost not greater than the expense for one of Peary's expeditions.

The estimated cost for the establishment of the proposed station reaches the very moderate amount of $9,400, which would cover the erection of building, purchase of a motor launch, boats, sledges, tents and other material for shorter expeditions, instruments, books, etc. The running expenses, including salary for a resident investigator and native assistants, are estimated at $2,960. Mr. Porsild has asked the Danish government for this sum, and in the interest of science it is sincerely to be hoped that his request will be granted. If that is done, Mr. Porsild expects to have the station in working order before next summer, and its doors will then be thrown open for investigators from any country. The geographical position of Greenland, and the similarity of conditions there with those of the northernmost part of this continent must necessarily appeal to Americans, and until the time arrives when a permanent biological station can be established in a suitable locality in Alaska, those engaged in arctic work will find the now proposed institution a place of interest. For reasons which will be given Greenland will always be the classical ground for certain lines of research, and, as Mr. Porsild says, there is no other place in the Arctic that offers such favorable conditions as the region in which he proposes to establish his station. The southern coast of Disko has the richest flora and the most luxuriant vegetation in northern Greenland. It is the northernmost point where all the different plant formations of Greenland are represented. Cretaceous and Tertiary formations with rich deposits of fossils occur, and both gneiss and basalt rock formations are here represented. The inland ice and the high mountains are easily accessible, glaciers in all stages, fjords and rivers, and the open sea give an excellent opportunity for investigations. All the main features of arctic climate are found here. The sun does not rise over the horizon for over six weeks, and for a still longer period of the summer it does not go down. The colony Godhavn is the center of commercial life in northern Greenland, and it has regular communication with Copenhagen.

The station will be in charge of a resident investigator, and accommodation will be provided for two visitors, who will have the use of all facilities the laboratory can offer, free of charge. By the establishment of this station the total expense to a visiting scientist will be reduced to about one third of previous cost. It is estimated that a stay for a summer will cost $375, this sum covering the fare both ways between Copenhagen and Greenland. A prolonged sojourn will add proportionally a small sum only.

Among the researches which should be carried on partly by the resident investigator, partly by visiting biologists, Mr. Porsild draws attention to the following general problems: What environmental factors cause the peculiar aspect of arctic plants and plant communities? What internal and external qualities make it possible for arctic plants to exist under conditions too severe for any other plants? These two headings necessarily include a great number of special inquiries into structure, nutrition, growth, respiration, transpiration, variation and adaptation, flowering and propagation of plants, development, competition and succession of plant communities, problems for the solution of which the conditions in the arctic regions are especially favorable, but which require detailed experiments and observations, covering a long period of time. In the preface to his principal work, 'Plant Geography upon a Physiological Basis,' the late Professor A. F. W. Schimper (1898) suggests the foundation of a botanical station such as now proposed by Mr. Porsild, when he says: "It is to be hoped that a counterpart to Buitenzorg may soon be established in the arctic zone; for an arctic laboratory, with a modest equipment corresponding to the poverty of the flora and the relative simplicity of the problems to be solved would be of great service." Only a few problems of plant physiological interest may here be mentioned as subjects for investigation at a botanical laboratory in the Arctic. It has recently been shown that a great number of arctic plants are supplied with mycorrhiza. The question has arisen to what extent ready prepared food material is absorbed by means of this symbiotic relation under the prevailing light conditions in the arctic region. The process of photosynthesis in green plants must necessarily be retarded by the insufficient light. It is generally supposed that the long arctic day is a compensation to the plants for the short period of growth. This has not yet been proved, however, by real evidence. We do not know, as yet, how small amount of light is necessary to bring about absorption of carbon-dioxide in the green plants of the Arctic. We have no data, except occasional observations by travelers, as to the peculiar results on vegetation of the Arctic temperatures. Such facts as willows flowering and budding as soon as they reach over the surface of the snow, while their lower parts are still frozen, are, as yet, unexplained. Similarly the phenomenon of plants growing and flowering on steep mountain sides, where they are exposed to a temperature of 30° C. in daytime and several degrees under zero at night, and to extremely low temperatures in winter without any snow-covering. The adaptations in arctic plants for conservation of the water supply or minimizing the transpiration are still imperfectly known. The ecology of roots of arctic plants is hardly studied at all. The succession of plant communities on new soil, left bare by the ice, is a problem which can not be studied to advantage anywhere better than in Greenland, where similar conditions now prevail as once obtained in the glaciated area of both the northern and the southern hemisphere. These are only a few of the most important botanical questions which have to be solved at an arctic station.

The resident investigator should make detailed meteorological observations. Near the proposed site for the laboratory are mountains 2,000 to 3,000 feet high, and easily accessible. Mr. Porsild proposes to place self-registering instruments in a hut on the top of the mountain, so that simultaneous readings could be had from near sea level and from the high mountain—a matter of great consequence. In this connection also phenological observations would be taken.

Among the problems of geological interest, for the study of which Greenland offers special advantages, may be mentioned the study of glaciation, and of the extremely rapid erosion, that takes place in the northern part of the country. Certain parts of the coast are known to be sinking, in the basaltic regions of north Greenland earthquakes are not infrequent, and a trained observer, living in the country the whole year round and supplied with necessary instruments, could do good service by obtaining data on these phenomena. Large collections of plant fossils have already been brought home from these regions, but still much remains to be done in paleontological research.

Of zoological subjects especially plankton studies could be undertaken, and a series of observations of the periodicity of plankton, together with data on salinity and temperature of the sea water would be of considerable interest for an understanding of the animal life in the high arctic seas.

Mr. Porsild, who is now connected with the botanical department of the University of Copenhagen, has already done good work in the study of arctic plant life, and if he undertakes the work of the resident investigator, it can be taken for granted that results of permanent value to biological science will follow the founding of the new institution. The plan of establishing an arctic biological station in north Greenland, as proposed by Mr. Porsild, has received the endorsement of all the scientific institutions in Denmark, and the hearty approval of scientists in northern Europe. It now remains to be seen whether the Danish government is aware of the importance of this proposal and willing to take the necessary steps for its realization.

Pehr Olsson-Seffer.
Stanford University, Cal.,
December 5, 1904.

SPECIAL ARTICLES.

THE DEXTER, KANSAS, NITROGEN GAS WELL.*

During the first half of 1903 parties drilling for oil or gas at Dexter, Kansas, came into a gas sand at a depth of about 400 feet which yielded a large amount of gas. It was soon closed in and an attempt was made to burn it, as natural gas is usually burned, for generating steam for drilling purposes. Much to the surprise of parties interested, it would not burn. Later it was found that when a fire was already kindled in a fire box or an engine and the gas turned on, as is usually done with natural gas, it would begin to burn, and would develop sufficient heat to generate steam moderately well. But as soon as the coal or other fuel in the fire box was consumed the gas would no longer burn. A cylinder of the gas was shipped to the University of Kansas later during the summer and was partially examined by different members of the chemical and geological departments.

This peculiar gas obtained from the ground in a manner similar to the way natural gas is ordinarily obtained, and in a region where gas might reasonably be expected, at once became an object of great interest. The owners of the well, who had spent their money in developing it, did not wish it given great publicity. But newspaper men wrote it up and oil and gas men generally spoke of it as a well of 'hot air.' Accordingly, the state geologist deemed it of sufficient interest to warrant a careful investigation. On his advice the well

* Presented in abstract at the meeting of the Geological Society of America at Philadelphia, December 30, 1904.

was opened up and allowed to flow freely through an 8¼-inch pipe for eleven days, and then through a 3-inch pipe three days more. The gas was again tested by trying to burn it in boilers, stoves and other places. But it was found to have practically the same character as when first obtained. During this long flow the well 'drilled itself in' to a considerable extent; that is, the escaping gas broke the upper part of the gas-bearing sandstone, blew the particles out through the casing and thereby deepened the hole. The static pressure of the gas at present is 120 pounds, and the flowage capacity, measured by the ordinary method using the pitot tube and Robinson's tables, is reported to be seven million cubic feet per twenty-four hours. These measurements have not been verified by the state survey, but the parties making them are so well known it is safe to assume they are approximately correct.

An ordinary gas-receiving cylinder with an opening at each end was now shipped down to the well and was filled with gas by the ordinary replacement method, the cylinder first being filled with water. The full pressure of the well was admitted to the cylinder, the valves securely closed, and the same shipped to Lawrence for analysis. The analysis of the gas was made by the junior author of this article and gave results as follows:

Oxygen	0.20
Carbon dioxide	0.00
Carbon monoxide	0.00
Methane, CH_4	15.02
Hydrogen	0.80
Nitrogen	71.89
Inert residue	12.09
Total	100.00

The analysis was carried out chiefly by means of the well-known methods given in Hempel's 'Gas Analysis.'

Methane was determined by combustion of the gas with pure oxygen and measurement of the resulting contraction, and also of the carbon dioxide formed in the combustion. Hydrogen was absorbed in a palladium tube; carbon dioxide was tested for with a potassium hydrate pipette and carbon monoxide with ammoniacal cuprous chloride solution. For the determination of oxygen a phosphorus pipette was used. The residual gas left unabsorbed after all the above operations was treated by the method used by Ramsay and Rayleigh in the separation of argon from atmospheric nitrogen (*Journal of London Chemical Society,* 1897, 181). The residue was mixed with an excess of pure oxygen and confined in a tube over mercury. A small quantity of a strong solution of potassium hydroxide was introduced into the tube over the mercury and a spark from an induction coil was passed through the mixture for about sixty hours. The nitrogen peroxide formed in the operation was absorbed by the solution of potassium hydroxide. The sparking was continued for several hours after all contraction in the volume of the gas had ceased, and the residue was then removed from the tube and passed into a phosphorus pipette filled with fresh phosphorus. Here it was kept for several hours to insure the complete absorption of the excess oxygen. The residue which failed to be absorbed was then measured. This constitutes the portion which is designated in the analysis as inert residue. No examination into the constitution of this residue has yet been made, because of lack of time, and until this is done nothing can be said concerning its composition, save that there is a possibility of its containing argon or other inert gaseous elements which have been found in atmospheric air.

The investigation of the inert gases will be carried out as soon as time will permit.

Geologically the mouth of the well is in the Permian, and the gas-bearing sandstone is close to the division line between the Upper Coal Measures and the Lower Permian. No caves or underground caverns of any importance ever have been found in this part of the state. The formations are a mixture of alternating beds of limestone and shale, with comparatively small amounts of sandstone found here and there in the shale. The gas itself, it should be remembered, occurs in sandstone in the same manner that ordinary natural gas occurs in other sandstones farther east. Naturally one is led to inquire whence this large amount of nitrogen which has already flowed from the well, an amount equal to not less than 125 million cubic feet measured at atmospheric pressure. A little farther east in the state there are hundreds of natural gas wells which produce a natural gas similar to that of Indiana, Ohio and Pennsylvania. For comparison a few analyses from different places in the state are here added, made by Professor E. H. S. Bailey, of the University of Kansas, years ago.

CHEMICAL COMPOSITION OF KANSAS NATURAL GAS. EXPRESSED IN PER CENTS.

Components of Gas.	Paola.	Osawatamie.	Iola.	Cherryvale.	Coffeyville.	Independence.
Hydrogen, H	0.00	0.00	0.00	0.00	0.00	0.00
Oxygen, O	0.45	trace	0.45	0.22	0.12	trace
Nitrogen	2.34	0.60	7.76	5.94	2.21	3.28
Carbon m-oxide, CO.	1.57	1.33	1.23	1.16	0.91	0.33
Carbon dioxide, CO_2	0.33	0.22	0.90	0.22	0.00	0.44
Ethylene series, C_2H_4, etc.	0.11	0.22	0.00	0.00	0.35	0.67
Marsh gas, CH_4	95.20	97.63	89.66	92.46	96.41	95.28

It will be seen from the above table that oxygen is present in small quantities in almost all the samples analyzed and that nitrogen is present in all of them, reaching to a little over seven per cent. in gas from Iola. It is possible, of course, that a small amount of air was left in the gathering flask, but not probable. If so the amount of oxygen present would correspond to a proportionate amount of nitrogen, much less than is given in the table. Therefore, we may conclude that traces of nitrogen are usually present in Kansas natural gas. Carbon monoxide and carbon dioxide also are present in small quantity, but almost all the volume is marsh gas, CH_4, which reaches 97.63 per cent. in one sample. But in the Dexter gas no oxides of carbon could be found.

If we assume that the Dexter gas represents a volume of air which in some way was embedded hundreds of feet beneath the surface, then a number of interesting inquiries are presented, such as: What became of the oxygen? If it was consumed or absorbed by organic matter then why is the gas totally void of the oxides of carbon which are found present in small quantities in almost all natural gases? Is it possible that ground water absorbed the oxygen from a mass of air, leaving large quantities of nitrogen unabsorbed? Under ordinary conditions the ratio of absorption for oxygen and nitrogen by water is different from the ratio between the two gases in the atmosphere. It is possible that ground water simply absorbed the oxygen, leaving a residue of nitrogen unabsorbed. It must be confessed this hardly looks probable. But even if it is possible the most important question yet remains, namely, how did so large a volume of air become entombed in the ground? The writers hereof are unable to advance any views on this phase of the subject.

Erasmus Haworth,
D. F. McFarland.

COMMENT.

Under the view that the earth's atmosphere and hydrosphere represent volatile matter forced out from the interior of the shrinking globe, the Dexter nitrogen supply is simple and natural. It is one of many indications that the interior supply of gases is not exhausted and that the atmosphere is still growing.

H. L. Fairchild.

THE TEACHING OF AGRICULTURE IN SOUTH CAROLINA.

Clemson Agricultural College of South Carolina has recently completed a commodious building for the purpose of teaching the sciences related to agriculture. This building was dedicated to its use on August 9, by appropriate exercises. On that occasion Hon. J. E. Tindal, of South Carolina, delivered an address and dedicated the building to the prosecution of agricultural sciences. There was present a large audience of farmers and prominent men from different portions of South Carolina and neighboring states. The following is a synopsis of Mr. Tindal's speech:

The dedication of the building, he said, marks the seeming completion of the college. This building was put up last because the work of agriculture could be carried on better than could the work of other departments without separate buildings. The money was not available to erect all buildings at once. Those in greatest demand were built first. The college is now complete with six departments. These six departments represent the great industrial forces of our great state. We are making a new era, but that era did not begin with reconstruction. South Carolina University was abolished and the South had nothing to do with that monstrosity. It began with 1876. The old South Carolina College was established. The negroes were given a college at Orangeburg, and the citadel was given to the whites at Charleston. But the old classical education, while good and while still good, did not go far enough.

The wonderful advance along industrial lines has wrought a revolution in all departments of life. These new forces of nature have been applied to all professions and trades. No education can be adequate that does not take these forces into consideration. Clemson College was founded to meet the very necessities of the times in which we live.

No individual can master the whole of the knowledge of this generation. But a man may master the world's thought in his own particular vocation. If a state has men who do this, then that state stands at the very forefront of progress. For a long time agriculture was neglected. But the learned men of Europe soon saw that the business of the world would collapse unless attention was given to agriculture. So experiment stations have been established where learned men pry into the secrets of nature as they affect human life. If any new discovery is made in any department of science, your professor of that particular line gets it and gives the benefit to our state.

Knowledge has so multiplied that men must specialize. The man who does so gains distinction and wealth and is a benefactor of the race. A man who masters the forces of nature and applies them to his vocation deserves respect. He deserves it when he is a farmer just as much as when he follows any other calling. When farmers begin to specialize then we shall have diversified farming.

You claim that we spend too much money. Why, we don't spend an infinitesimal part of what we ought to spend to bring our state abreast the times. Japan, though not much larger than South Carolina, has 175 experiment stations.

Clemson has awakened thought in our state. The farmers are beginning to realize that there is something to learn besides what they already know. It has got them out of ruts.

The success of this college depends on you. If you have a bright boy and want him to become a doctor, you send him to college; so if you want him to become a lawyer. But if he is to farm you turn him loose in ignorance. Why not educate him too?

South Carolina depends on you. This land is your inheritance. It should be the inheritance of your children. If it is to be, you must get the best knowledge obtainable.

Here Captain Tindal addressed himself to the faculty of the college, impressing upon them the responsibilities that rested upon them, and complimenting them upon what they had done. He spoke of the contribution the other departments of the college had made to the nation, but the state must look largely to the agricultural department.

Captain Tindal's speech was scholarly and forceful and was listened to with interest.

The agricultural hall contains thirty laboratories and lecture rooms. The sciences have been well provided for—general agriculture, geology and mineralogy, veterinary science, botany and bacteriology, horticulture, entomology and zoology, animal husbandry and dairying. The state experiment station is also located in this building. The board of trustees have endeavored to furnish these laboratories and lecture rooms with the best apparatus and appliances so that the teaching and experiments may be conducted in accordance with modern requirements There is also a large room in this building set aside for a museum, where the different divisions and departments will display for the use of the students scientific specimens which will also be of value to the casual observer, and to the man who is investigating some special topic in his line. The structure consists of three floors, and is built of the best material available, finished in pressed brick and stone trimmings.

The work of Clemson Agricultural College in the line of agriculture has been greatly advanced within the last several years because of the active demand on the part of the farmers for information concerning their profession. They assemble here each year in large numbers during the middle of the summer, and spend a week with the professors of the institution and distinguished experimenters from other sections of the country, in the study of sciences relating to agriculture. The erection of this building, therefore, has been in accordance with this demand. The board of trustees are endeavoring to meet the requirements of the situation, and there is great desire on their part to give all the facilities, so far as the income of the college will allow, not only for the purpose of teaching agriculture, but at the same time for encouraging original research on the part of the gentlemen who have charge of the various divisions in the department. There seems to be a considerable awakening on the part of the people all over the state for knowledge in scientific agriculture, and in other lines of industry, and the erection of this building with its modern facilities will go far towards encouraging this awakening on the part of the industrial classes of the state.

The college was established in 1889 by an act of the state legislature, and opened for the admission of students in 1893. The first class graduated in 1896, and the college has sent out a total number of 295 graduates. The total number of students enrolled for session 1904–5 is 641, and the total number of the faculty is 44.

The college is engaged in work in the following lines of scientific and industrial activity—agriculture, mechanical engineering, electrical engineering, civil engineering, textile engineering, chemical science and the subjects of general literature necessary for an educational foundation.

The college is located on the estate of John C. Calhoun, his mansion being situated in the center of the campus. Mr. Thos. G. Clemson, son-in-law of John C. Calhoun, donated the property to the state for the purpose of a college of this character, giving 800 acres of land and $58,539 in securities. The state has added to the land so that it now amounts to 1,136 acres. The board have spent in the fifteen years since the college was founded $656,721 in the preparation of the grounds, the installation of electric lights, water works, sewerage system and the erection of nine large buildings, 36 smaller structures for college purposes and 57 residences for the faculty. The departments are well equipped with appliances and apparatus for the prosecution of work along the lines required in modern colleges.

The income of the college is from several sources and amounts to $150,287. Besides the educational work, the college is required by law to carry on experiments in agriculture for the benefit of the farmers of the state and is in charge of the inspection of fertilizers, plants and animals, and is conducting elaborate courses of farmers' institute work. It will thus be seen that Clemson College is endeavoring to do for the industrial classes of South Carolina advanced and valuable work.

The limit of age for admission to the college is sixteen years. Every year the authorities are compelled to turn off a large number of applicants for the lack of the facilities to take care of the students who are striving for the scientific education given by colleges of this character.

P. H. Mell.

Clemson College, S. C.

SCIENTIFIC NOTES AND NEWS.

The city of Berlin has arranged a competition for plans for a monument to Rudólf Virchow. It is to be placed at the intersection of Karl and Luisen Streets, a square which will henceforth be known as Virchow Platz.

Professor Lewis Boss, astronomer of the Dudley Observatory of Albany, N. Y., has been awarded the medal of the Royal Astronomical Society.

The Botanical Society of America elected the following officers at the recent Philadelphia meeting: *President,* Professor R. A. Harper; *Vice-President,* E. A. Burt; *Secretary,* Dr. D. T. MacDougal; *Treasurer,* Dr.

Arthur Hollick; *Councilors,* Professors L. M. Underwood and William Trelease.

The famous singing master, Manuel Garcia, of London, who invented the laryngoscope fifty years ago, will be 100 years old March 17, 1905. The London Laryngological Society is collecting subscriptions for a present to be given to him on that occasion.

Dr. L. P. Kinnicutt, the head of the chemical department of the Worcester Polytechnic Institute, has been appointed by President Roosevelt one of the commissioners to examine and test the fineness and weight of the coins reserved by the several mints of the United States during the calendar year 1905.

Professor H. Marshall Ward has been elected president of the Cambridge Philosophical Society.

Mr. R. V. Anderson, a student in the department of geology of Stanford University, has sailed from San Francisco for Japan, where he will make a special study of geological conditions.

Assistant Professor Leonard E. Dickson, of the department of mathematics of the University of Chicago, has completed his investigations as research assistant to the Carnegie Institution of Washington for 1904.

Captain John Donnell Smith, of Baltimore, has given to the Smithsonian Institution his private herbarium consisting of more than 100,000 mounted sheets and his botanical library of nearly 1,600 bound volumes. Captain Smith's collection is probably the largest private herbarium in America, being very rich in tropical plants. As is well known Captain Smith has long been a student of the flora of the Central American countries, having published many systematic papers on the flora of Costa Rica and Guatemala. He proposes to continue these studies, and for this reason will retain for the present the custody of the greater part of his herbarium. This gift is the most important of the kind ever received by the Smithsonian Institution.

The Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology has received from the William E. Hale Research Fund a second grant of $1,000, which is being applied to an investigation upon the conductivity of fused salts carried out by Mr. R. D. Mailey under the direction of Professor H. M. Goodwin. The Carnegie Institution has also renewed the grant of $2,000 to Professor A. A. Noyes for the purpose of promoting the researches in progress in the laboratory upon the conductivity of salts in aqueous solutions at high temperatures, which are being executed by Professor W. D. Coolidge. Mr. A. C. Melcher and Y. Kato. Additional investigations are being carried on by four other research associates or research assistants as follows: upon the rate of decomposition of minerals by water by Dr. W. Böttger; upon the migration and coagulation of colloids by Dr. J. C. Blake; upon the physico-chemical properties of the solutions of metals in liquid ammonia by Mr. C. A. Kraus; and upon the dissociation relations of phosphoric acid by Mr. G. A. Abbott. Other researches—upon the dissociation-relations of sulphuric acid, upon the solubility of salts in water above 100°, upon the heat of solution of substances in relation to their dissociation, and upon the qualitative detection of certain rare metals—are being pursued by candidates for the Ph.D. degree.

Research work in chemistry at the University of Michigan is represented among University organizations by the Chemical Colloquium, which meets twice a month through the year. Reviews are presented of recently published important researches, and reports are made upon investigations carried on in the university laboratory. All instructors of the department are members of the colloquium, and graduate students and those advanced in chemistry are also eligible to membership. The following topics have been discussed at the meetings this year: October 24, 1904—Professor Edward D. Campbell, 'A Review of Clifford Richards' Work on the Constitution of Portland Cement.' November 7—Dr. William J. Hale, 'Condensations with Nitromalonic Aldehyde.' November 21—Professor S. Lawrence Bigelow, 'A Review of Some Recent Articles on Colloidal Solutions.' December 5—Assistant Professor Alfred H. White, 'The Decomposition of Ammonia by Heat'; a report of experimental work. December 19—Assistant Professor George A. Hulett, 'Revolving Electrodes and Electro-analysis.' January 16, 1905—Professor Moses Gomberg, 'A Review of the Literature in Tetravalent Oxygen.'

We learn from *The Botanical Gazette* that the Botanical Society of America, the Society for Plant Morphology and Physiology and the American Mycological Society, through committees of conference, have agreed upon certain general principles, upon the basis of which they will fuse into one national society under the name of The Botanical Society of America. For some years the names of all the societies will appear upon official publications until the union is thoroughly known. There are to be two classes of membership, members and associates, the distinction being placed upon published work. The fees are to be $5 a year. Grants for research are to be made from the income. Meetings are to be annual with no permanently organized sections, but free opportunity for local meetings or temporary sections in charge of committees. A joint committee has been formed to prepare a constitution for the united societies, which shall embody the principles agreed to, and complete the reorganization.

A cablegram to the New York *Herald* says that Professor Curie has sent through the Austrian ambassador, a tube of radium to the Vienna Hospital for use in the cure of lupus. The gift is a recognition of the act of the Austrian government in furnishing Professor Curie with pitchblende for his original researches.

The government of the northwest territories of Canada is establishing a new bacteriologic and pathologic laboratory and has appointed Dr. George Charlton, formerly of the McGill University pathologic department, chief of the laboratory.

The department of geology of the American Museum of Natural History has recently received a series of fossils from the beds of Hudson River age near Cincinnati, Ohio. All the specimens are in beautiful condition and many rare forms, especially of Echinoderms, are represented by several specimens.

The king of Italy has given $20,000 towards the expenses of the exhibition to be held in Milan in 1906 in celebration of the opening of the Simplon tunnel.

Among the recent contributions received by the Imperial Cancer Research Fund are the following: the Duke of Bedford, £1,000 (third instalment of £3,000); Mr. J. A. Mullens, £100; the Clothworkers' Company, £50 and Mr. Archibald Walker, £50.

Dr. W. Bell Dawson, the engineer in charge of the Tidal and Current Survey of Canada, has been awarded the Gay prize of 1,500 francs, by the Academy of Sciences of Paris. This prize was offered for the best determinations of mean sea level on the coasts of the North Atlantic Ocean. Such determinations serve either to detect any gradual change of the land elevation relatively to the ocean, or to establish a plane of reference for general levels throughout the country. Although this is additional to the direct work of the Tidal and Current Survey as a marine undertaking, Dr. Dawson has evidently given special attention to this matter. As there are yet no general geodetic levels throughout Canada, he has established independent bench-marks at all the more important harbors and other localities where tidal observations have been obtained. These are at widely separated points, from Labrador to Nova Scotia, and from the St. Lawrence to Newfoundland. The resulting tide levels are described in his recent paper in the *Transactions of the Canadian Society of Civil Engineers,* entitled 'Tide Levels and Datum Planes in Eastern Canada.' It is the work there detailed, and explained in his other reports and papers on tidal subjects, that formed the basis of the award of the prize referred to.

Mr. S. Harbert Hamilton announces that he has sold to the Carnegie Museum, Pittsburgh, Pa., the famous W. W. Jefferis collection of minerals, with the understanding that it is to be known in perpetuity as the 'W. W. Jefferis Mineral Collection of the Carnegie Museum.'

Mr. Jefferis began the collection of minerals more than seventy years ago. Living, as he did, at West Chester, Chester County, Pa., he had unusual opportunities of collecting choice specimens from the ancient gneiss, serpentine and limestones, as well as the trap rocks, of eastern Pennsylvania, New Jersey and New York. Mining was then carried on more extensively than now in this region. Mr. Jefferis's exertions were not confined by any means, for he traveled in northern New York, Canada and Europe in search of minerals. He conducted exchanges with collectors all over the world, sending out hundreds of boxes of minerals. He also spent as lavishly of his means as he did of his time in building up a marvelous collection with the eye of a connoisseur, so this which now goes to Pittsburgh is one of the finest private American collections. Mr. Jefferis, although primarily a collector, was also a discoverer and contributor to science. He furnished Geo. Brush, J. Lawrence Smith, C. U. Shepard, F. A. Genth, J. P. Cooke, J. D. Dana, F. W. Clark and many other investigators with material, as the files of original letters which go to Pittsburgh abundantly testify. Aquacreptite (Shepard), Euphyllite (Silliman, Jr.), Jefferisite (Brush), emerald nickel = Zaratite, Melanosiderite (Cooke), Roseite (Jefferis) were all discovered by Mr. Jefferis. In addition to new minerals Mr. Jefferis aided largely in extending the distribution of known species and in furnishing material for the reexamination of old and poorly known ones. Dana drew largely from Mr. Jefferis's notes and specimens, some of which were figured for his System of Mineralogy. Genth's 'Mineralogy of Pennsylvania' is also greatly indebted to Mr. Jefferis's labors in the field.

Miss Julia A. Lapham has been appointed chairman of the recently organized Landmarks Committee of the Wisconsin State Federation of Woman's Clubs. Under her leadership the ladies of the state are taking an active interest in the movement for the preservation of the animal effigy mounds and other prehistorie monuments and landmarks of Wisconsin. Miss Lapham lives at Oconomowoc and is the daughter of the late Dr. Lapham, the pioneer authority on the archeology of Wisconsin. It will be remembered that it was the women of Boston who saved the Serpent Mound of Ohio.

The books of the engineering library at the University of Michigan, which have hitherto been shelved in the general library, are soon to be transferred to a room set apart as a library in the new engineering building. The collection will be recatalogued and regarded hereafter as a department library. Miss Olive C. Lathrop has been appointed assistant librarian in charge of the collection.

During the past summer Mr. C. W. Purington, a mining engineer of Denver, accompanied by Mr. Sidney Paige as assistant, journeyed through Alaska, investigating, for the U. S. Geological Survey, the costs and methods of gold-placer mining in the territory. For the purpose of making comparative observations, he also visited the Atlin district of British Columbia and the Klondike gold fields of the Yukon territory. In studying the conditions which affect placer mining in our northern possessions, he was impressed with the present inadequate means of communication between the different parts of the territory. The gold mining which has been done in the interior of Alaska has been conducted in spite of difficulties of transportation which seem hardly credible. Mr. Purington advocates the appointment of a civil-service officer who shall be general superintendent of road construction in Alaska, and believes that there should be appointed, under the general superintendent, properly qualified road overseers in each district of Alaska. He also indorses the recommendation made by Mr. A. H. Brooks, geologist in charge of the division of Alaskan Mineral Resources, U. S. Geological Survey, that an appropriation of $1,000,000 be spent for wagon roads in Alaska. He thinks it probable that for this sum 900 miles of roads—300 of the Dawson standard wagon type and 600 for sleds—could be built in those parts of the country which would be most assisted by their construction.

Mr. Richardson, of Alabama, introduced in the House of Representatives, on January 23, a bill which is sufficiently curious to deserve partial quotation. It begins: "*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the Secretary of the Treasury be, and he is hereby, authorized and empowered and directed to pay, out of any money in the Treasury not otherwise appropriated, a sum not exceeding five hundred thousand dollars, for the organization and maintenance of an expedition, to be known as physical-phenomena association for the promotion of science expedition, the purpose of which shall be to seek, discover and investigate facts connected with the deep sea, the temperature, pressure, chemical properties, fauna, vegetation, character of the deep-sea bottom, volcanic disturbances and any and all phenomena relative to the ocean, for the cause and advancement of physical science generally. To facilitate the purpose of the expedition the Secretary of the Navy is authorized, immediately after the passage of this bill, to equip a ship suitable for said purpose, and to employ a first-class crew for the management of said ship. Immediately after the passage of this bill, or as soon thereafter as practicable, the President shall, with the concurrence of the Senate, appoint four chemists, who are learned in the science of chemistry, at a salary of three thousand dollars each per year; two geologists, who are learned in the science of geology; two astronomers, who are learned in the science of astronomy; two naturalists, who are learned in the science of natural history; two botanists, who are learned in the science of botany; two zoologists, who are learned in the science of zoology; and ten other scientists, if deemed practicable by the President, who are respectively learned in the sciences for which they are chosen, each at a salary of two thousand and five dollars per annum each. The President shall also appoint two persons, who are interested in the sciences generally, from each State, upon the recommendation of the Senators from each State, at salaries of three thousand dollars each, all of whom, after they shall have been appointed and confirmed as aforesaid, shall be members of the said expedition."

UNIVERSITY AND EDUCATIONAL NEWS.

The trustees of the Peabody Education Fund met at Washington on January 20 and voted to dissolve their trust. An appropriation of $1,000,000 for the George Peabody School for Teachers in Nashville, Tenn., was made by a unanimous vote, the state, county and city having together appropriated an equal sum for the school. This appropriation leaves a fund of approximately $1,200,000, which will be distributed later among other educational institutions, probably at the next annual meeting, which will be held next October in New York. The trustees have authority to distribute two-thirds of the fund in the south, and the remainder in the north, but it is probable the entire fund remaining will be devoted to southern institutions.

At the midwinter meeting of the trustees of Syracuse University it was voted to construct, with the bequest made to the university by the late John Lyman, which is said to aggregate more than $200,000, a building to be known as the John Lyman Laboratory of Natural History.

Mr. Andrew Carnegie has promised Oberlin College a gift of $125,000 for the erection of a library building, conditional on the raising of $100,000 for endowment by the citizens.

Mr. Adolph Lewisohn, of New York, has given $5,000 for the reconstruction of the chemical laboratories at Dartmouth College.

The New York Post-Graduate Medical School and Hospital has received an anonymous gift of $5,000.

Emperor William has directed the German ambassador to the United States to lay before President Roosevelt in official form the suggestion for an exchange of professors between German and American universities, which he made to the American ambassador on New Year's day. The German ambassador, who sailed on the *Kaiser Wilhelm der Grosse,* on January 25, only carries an outline of the project, for which the president's approval and cooperation in making a workable plan will be asked.

The Baltimore Association for the Promotion of the University Education of Women is prepared to offer a fellowship of the value of $500 for the year 1905–1906. This fellowship will be available for work at either an American or a foreign university, and preference will be given to women from Maryland and the south. Application should be presented before April 12. Blank forms for application may be obtained from Miss McLane, No. 1101 North Charles Street, Baltimore.

The president of the British board of education has appointed the Right Hon. R. B. Haldane, K.C., M.P., to be chairman of a departmental committee "To inquire into the present working of the Royal College of Science, including the School of Mines; to consider in what manner the staff, together with the buildings and appliances now in occupation or in course of construction, may be utilized to the fullest extent for the promotion of higher scientific studies in connection with the work of existing or projected institutions for instruction of the same character in the metropolis or elsewhere; and to report on any changes which may be desirable in order to carry out such recommendations as they may make."

We noted last week that the regents of the University of Michigan, had refused to accept President Angell's resignation. Dr. Angell's communication to the board of regents was as follows:

To the Board of Regents:

I beg to tender you my resignation of the presidency of the university, to take effect Oct. 1, next. Although I have been graciously favored in the preservation of my health and strength, I am impressed with the belief that it will be advantageous to the university if you call a younger man to take my place.

I desire to express my sincere thanks to you and to your predecessors on the board for the kind consideration with which I have been treated by you and by them during my long term of service.

Should you so desire, I should be willing to continue to give instruction in international law.

Yours very respectfully,
James B. Angell.

The following resolution was immediately drawn up and unanimously adopted by the regents. Instead of being marked 'passed' as is customary with routine resolutions, it was submitted to each member and received his signature:

Resolved, That the Board of Regents respectfully decline to consider Dr. Angell's resignation of the presidency of this university. The members of this board are unanimous in the conviction that no other person, young or old, can take President Angell's place either in value of service to the university and to the state, or in the love of the people.

If at any time in the judgment of President Angell, he should need assistance in his work, the Board of Regents will most cheerfully furnish such assistance in such form as he may wish.

Mr. Louis Rouillion, adjunct professor of manual training in Teachers College, Columbia University, and director of the night schools of the Mechanics' Institute, has been given leave of absence in order to enable him to accept the appointment of chief inspector of technical education for Ireland.

At the recent meeting of the board of trustees of the Iowa State College, Professor S. A. Beach, horticulturist to the New York Experiment Station, was elected professor of horticulture, and horticulturist to the Iowa Experiment Station. This position has been vacant during the past year, due to the resignation of Professor H. C. Price, who resigned to become dean of the College of Agriculture of the Ohio State University. Professor Beach is an alumnus of the Iowa Institution and has been connected with the New York station for a number of years. He is now engaged in the publication of an important work on the pomology of New York for which the legislature made a special appropriation of $20,000. At the same meeting of the board Mr. A. T. Erwin, an assistant in the department, who has been the acting head during the past year, was elected associate professor of horticulture.

Mr. Thomas Case, Waynflete professor of moral and metaphysical philosophy, Oxford, and fellow of Magdalen, has been elected president of Corpus Christi College, in succession to the late Dr. Fowler.

SCIENCE

NEW SERIES. VOL. XXI. NO. 528. 8637 FRIDAY, FEBRUARY 10, 1905. SINGLE COPIES, 15 CTS. ANNUAL SUBSCRIPTION, $5.00.

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 10, 1905.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE CARNEGIE INSTITUTION OF WASHINGTON.**

MINUTES OF SECOND MEETING OF THE BOARD OF TRUSTEES. [ABSTRACT.]

THE meeting was held in Washington, at the New Willard Hotel, on Tuesday, December 13, 1904, at 10 o'clock A.M. At 12:55 a recess was taken until 2 P.M. The chairman, Mr. Billings, occupied the chair. The secretary called the roll, and the following trustees responded: Messrs. Billings, Cadwalader, Dodge, Frew, Gilman, Hay, Higginson, Hitchcock, Hutchinson, Langley, Lindsay, Low, MacVeagh, Mills, Mitchell, Morrow, Root, Walcott, White and Wright. Absent: Messrs. Agassiz, Howe, Gage and Spooner. Letters were received from Messrs. Agassiz, Gage and Howe regretting their inability to be present.

The minutes of the last meeting of the board were presented, and on motion full reading was dispensed with and they were approved as per abstract furnished each member.

The president presented his resignation, as follows:

CARNEGIE INSTITUTION OF WASHINGTON,
December 13, 1904.

TO THE TRUSTEES OF THE CARNEGIE INSTITUTION.

Gentlemen: At your meeting, on December 8, 1903, I presented a letter saying:

"When I had the honor of being chosen the first president of the Carnegie Institution, I said to the trustees that from the nature of the case my tenure of office must be short, for, having passed the age of seventy years, I was looking forward to a release from serious official responsibilities.

* From Year Book, No. 3.

The term of five years was fixed in the by-laws, and three of them will have passed at the next annual meeting of the board. It is my intention at that time to resign the office of president, and this early notice is given in order that the trustees may be prepared then to take such action as may seem to them wise."

In accordance with this intimation, I now resign the office of President of the Carnegie Institution, and, as the title of the chief executive may, perhaps, be changed, I will add that I am not a candidate for reappointment under any other designation.

In taking this step, I beg leave to assure the board of my continued interest in the development of this institution according to the purposes of the founder; and I express to the members of the board, collectively and individually, my highest respect.

It has been an honor and a privilege to be so closely associated as I have been with the organization and progress of an institution which bids fair to be a most potent factor in the advancement of knowledge and in the encouragement of scientific men.

I am, gentlemen, very respectfully yours,

Daniel C. Gilman.

The following motion was then offered and passed:

Resolved, That the resignation of President Gilman be accepted; and in thus severing the harmonious relations which have existed between the president and the board and the president and the executive committee the trustees desire to express their full appreciation of the prestige that the retiring officer has brought to the Carnegie Institution of Washington by his presidency.

The secretary referred to various details of business and submitted the cash statement and financial statement as shown below.

The secretary also reported that since October 31, 1904, he had collected on sales of publications $589.01, and expended $31,-895.21, leaving a cash balance on hand of $438,654.97 to date.

The consideration of the by-laws was next taken up.

After discussion and various suggestions as to the qualifications needed by a president of the Carnegie Institution at Washington, a ballot resulted in the election of Dr. Robert S. Woodward, dean of the scientific faculty of Columbia University, New York.

The election of members of the executive committee to fill the vacancies caused by the expiration of the terms of Messrs. Billings and Walcott resulted in their reelection to the class of 1907.

On submission of the report of the executive committee the chairman and secretary made a general statement of the plan of work and financial outlook. After discussion and some minor changes, resolutions were passed making the following general appropriations:

Reserve fund	$ 50,000
Publication fund, to be continuously available	40,000
Administration	50,000
Grants for departments and large projects	310.000
Grants for miscellaneous researches	168,000

At 4:50 P.M. the board adjourned.

Financial Statement.

	Dr.	Cr.
Endowment		$10,000,000
Reserve Fund		200,000
Investments:		
U. S. Steel Corporation Bonds, 5%	$10,000,000	
$100,000 Atch., Topeka and S. Fe Ry. Co. Gen'l Mtg. 4% 100-year Gold Bonds, Oct. 1, 1995.	100,112 50	
$100,000 N. Pac. Ry. Co. Prior Lien Ry. and Land Grant Gold Bonds, Jan. 1, 1997, 4%	101,800	
$50,000 Northern Pacific-Great Northern 4% Joint Bonds, Chicago, Burlington and Q. collateral, July 1, 1921	46,500	
$50,000 Lake Shore and Mich. Southern 4% D. Bonds	48,222 22	
Interest: Reserve fund investment		10,000
Other investments		380 69
Sales of publications		102 03
Grants: Large		69,321 24
Special		13,250 80
Minor		77,174 13
Publication		67,470 65
Administration		25,630 08
Furniture		1,065 51
Seal		1,500
Cash	469,961 17	
Available fund		300,700 76
	$10,766,595 89	$10,766,595 89

Receipts.			Amount.
1903.			
October 31. Balance			$445,471 69
Interest:			
U. S. Steel Corporation.	$500,000		
Atchison, Topeka and S. Fe Ry. Co	5,000		
N. Pacific Ry. Co	4,500		
N. Pacific-Gt. Northern	2,500		
Lake Shore and Michigan Southern	2,000		
Deposit U. S. Trust Co.	18,926 87		
Deposit Am. Sec. and Trust Co	77 39		
		$533,004 26	
Sales of publications:			
Index Medicus	2,370 47		
Year Book	52 85		
Other publications	12 75		
		2,436 07	
Revertments		329 33	
Marine Biol. Lab., Tortugas, Fla.: A. G. Mayer		669 70	
			536,439 36
			981,911 05

Disbursements.		Amount.
Investments:		
$50,000 N. Pacific-Gt. Northern 4 % Joint Bonds	$ 46,500	
$50,000 N. Pacific Ry. Co. Prior L. Ry. and L. Grant 4's	51,312 50	
$50,000 Atchison, Topeka and S. Fe. Ry. Co. G. Mtg. 4's	50,125	
$50,000 Lake Shore and Mich. Southern 4 % D. Bonds	48,222 22	
		$196,159 72
Large grants	49,848 46	
Minor grants	187,634 53	
Special grants	29,749 20	
		267,232 19
Publication		11,590 82
Administration		36,967 15
		511,949 88
Balance: U. S. Trust Co., N. Y.	461,902 46	
Balance: Nat'l City Bank, N. Y.	7,746 67	
Balance: Am. Sec. and Trust Co.	312 04	
		469,961 17
		981,911 05

Chas. D. Walcott,
Secretary.

REPORT OF EXECUTIVE COMMITTEE ON THE WORK OF THE YEAR.

The executive committee began consideration of the various directions and authorizations given by the board of trustees immediately after the adjournment of the board, December 8, 1903; also of matters recommended by the committee and approved by the board.

The work of the committee and its recommendations for the fiscal year 1904–1905 are shown in this report.

During the fiscal year the committee held eight meetings. Its organization continued the same as for the fiscal year 1902–1903. Mr. Gilman acted as chairman and Mr. Walcott as secretary.

APPROPRIATIONS.

At the annual meeting of the board, December 8, 1903, the following appropriations were made for large projects:

Tropical Pacific exploration		*$40,000
Department of Experimental Biology		70,000
Department of Terrestrial Magnetism		20,000
Trans-Caspian Expedition, archeological exploration		18,000
Geophysical research		25,000
Investigation of mineral fusion and solution under pressure	$50,012	
Study of elasticity and plasticity of solid bodies upon finite deformation	7,500	
Preparation of a bibliography of geophysics	5,000	
Department of Economics and Sociology		30,000
Bureau of Historical Research		8,500
		$211,500

* It being impracticable to secure the services of the person whom the executive committee expected to take charge of this work, the project was abandoned and the appropriation not drawn upon.

REPORTS ON LARGE PROJECTS.

DEPARTMENT OF EXPERIMENTAL BIOLOGY.

The subject of research in zoology was before the executive committee at its earliest meetings, and was under consideration for nearly two years before the specific recommendations for any large projects directly in charge of the Carnegie Institution were presented to the board of trustees. In Year Book No. 1 the special advisory committee on zoology made several recommendations of a broad bearing, one of them being that of establishing a permanent biological laboratory as a central station for marine biology in general. In the same Year Book there were printed two schemes for the establishment of biological experiment stations for the study of evolution—one by Dr. C. B. Davenport, who favored Cold Spring Harbor, Long Island, and a second by Professor Roswell P. Johnson, who favored a protected marine shore near fresh-water ponds. The executive committee consulted with many experts and carefully investigated the feasibility of making the Marine Biological

Laboratory, at Woods Hole, Mass., a central station. This was found to be impracticable, and the executive committee stated in its report to the board of trustees for 1903 that it had concluded that the best mode of dealing with this important field of research was to organize a biological experimental department, to which could be referred all questions and problems of evolution, specific differentiation, heredity, etc. This was to include the establishment of an investigating station at Cold Spring Harbor, where ground and some buildings were offered, and also the establishment of a collection and experimental marine biological station at the Dry Tortugas.

The above conclusions were accompanied by a recommendation that the department be established and allotments made to begin the work. The board of trustees approved the recommendations.

The department of experimental biology was organized by the appointment of Dr. Charles B. Davenport as director of the Station for Experimental Evolution at Cold Spring Harbor, Long Island, and Dr. Alfred G. Mayer as director of the Marine Biological Laboratory at the Dry Tortugas, Florida.

A grant of $34,250 was made to the station at Cold Spring Harbor, and of $20,000 to the Marine Biological Laboratory at the Dry Tortugas.

DEPARTMENT OF ECONOMICS AND SOCIOLOGY.

For the present purposes of the department the following named eleven divisions have been established, and the gentlemen whose names appear have been placed in charge of them, respectively:

Division 1. Population and Immigration.—Professor Walter F. Willcox, Cornell University, Ithaca, N. Y.

Division 2. Agriculture and Forestry, including Public Domain and Irrigation.—President Kenyon L. Butterfield, Rhode Island College of Agriculture and Mechanic Arts, Kingston, R. I.

Division 3. Mining.—Mr. E. W. Parker, Geological Survey, Washington, D. C.

Division 4. Manufactures.—Hon. S. N. D. North, Census Office, Washington, D. C.

Division 5. Transportation.—Professor W. Z. Ripley, Newton Centre, Mass.

Division 6. Domestic and Foreign Commerce.—Professor Emory R. Johnson, University of Pennsylvania, Philadelphia, Pa.

Division 7. Money and Banking.—Professor Davis R. Dewey, Institute of Technology, Boston, Mass.

Division 8. The Labor Movement.—Carroll D. Wright, 1429 New York Avenue, Washington, D. C.

Division 9. Industrial Organization.—Professor J. W. Jenks, Cornell University, Ithaca, N. Y.

Division 10. Social Legislation, including Provident Institutions, Insurance, Poor Laws, etc.—Professor Henry W. Farnam, 43 Hillhouse Avenue, New Haven, Conn.

Division 11. Federal and State Finance, including Taxation.—Professor Henry B. Gardner, 54 Stimson Avenue, Providence, R. I.

TERRESTRIAL MAGNETISM.

The subject of an international magnetic bureau is fully presented by Dr. L. A. Bauer in 'Year Book' No. 2, accompanying papers, pp. 203–212. The executive committee recommended to the board of trustees that a grant of $20,000 be made for magnetic research by the Carnegie Institution, it being proposed not to take up such magnetic work as is already well provided for by national bureaus, but only such as lies outside the proper sphere of activity of these bureaus, the nature of whose appropriations usually limit their work within the confines of their countries. Furthermore, the purpose is to gather together and unite in one harmonious whole all existing knowledge and facts, so that the directions in which future work can most profitably be accomplished will be set forth. The investigations promise not only to have scientific utility, but to reach results of great practical importance, *e. g.*, the determination of the magnetic data necessary for safe navigation at sea.

The favorable action of the trustees at the annual meeting in December, 1903, and the reference of the project to the executive committee resulted in the formation of a department of international research in terrestrial magnetism, with Dr. L. A. Bauer as director, and with authorization to begin work April 1, 1904. The first allotment was $20,000.

TRANS-CASPIAN ARCHEOLOGICAL EXPEDITION.

(Raphael Pumpelly, Newport, R. I., in charge. $18,000.)

In Year Book No. 2, pages 271–287, there is a brief report of Professor Raphael Pumpelly's first expedition to the Trans-Caspian region. The second expedition was for the purpose of archeological investigations in special areas noted on the first expedition. The following report is an indication of the character of the results obtained. The final report will be prepared as soon as practicable.

Professor Pumpelly left America in December, 1903. A week was passed in Berlin, where he engaged as archeologist Dr. Hubert Schmidt, of the Museum für Völkerkunde. Dr. Schmidt had excavated at Troy under Dörpfeld, and is an expert in prehistoric pottery. A month was passed in St. Petersburg in getting permission to excavate in Turkestan.

On the twenty-fourth of March work was begun at Anau, near Askhabad. The members of the party were Dr. Hubert Schmidt, archeologist; Ellsworth Huntington, R. W. Pumpelly; Langdon Warner, Hildegard Brooks, Homer Kidder, volunteer assistants.

SECONDARY GRANTS.

The following is a record of the grants, not already mentioned, made under the allotment of $200,000 for minor grants. A few reports on grants made in 1902–1903 are included, as the work under them was continued into the fiscal year 1903–1904:

ANTHROPOLOGY.

GEORGE A. DORSEY, Field Columbian Museum, Chicago, Ill. For ethnological investigation among the tribes of the Caddoan stock. $2,500.

WILLIAM H. HOLMES, director of Bureau of American Ethnology, Washington, D. C. For obtaining evidence relative to the history of early man in America. $2,000.

ARCHEOLOGY.

FREDERICK J. BLISS, New York, N. Y. For excavations in Syria and Palestine. $1,500.

GEORGE F. KUNZ, New York, N. Y. To investigate the precious stones and minerals used in ancient Babylonia, in connection with the investigation of Mr. William Hayes Ward. $500.

W. MAX MULLER, Philadelphia, Pa. For investigating monuments of Egypt and Nubia. $1,500.

WILLIAM HAYES WARD, New York. For a study of the oriental art recorded on seals, etc., from western Asia. $1,500.

ASTRONOMY.

LEWIS BOSS, Dudley Observatory, Albany, N. Y. For astronomical observations and computations. $5,000.

W. W. CAMPBELL, Lick Observatory, Mount Hamilton, Cal. For pay of assistants in researches at Lick Observatory. $4,000.

HERMAN S. DAVIS, Gaithersburg, Md. For a new reduction of Piazzi's star observations. $1,500.

GEORGE E. HALE, Yerkes Observatory, Williams Bay, Wis. For measurements of stellar parallaxes, solar photographs, etc. $4,000.

SIMON NEWCOMB, Washington, D. C. For determining the elements of the moon's motion and testing law of gravity. $2,500.

W. M. REED, Princeton Observatory, Princeton, N. J. For pay of two assistants to observe variable stars. $1.000.

SOLAR OBSERVATORY, MOUNT WILSON, CAL., Dr. George E. Hale, director. $15,000.

MARY W. WHITNEY, Vassar College, Poughkeepsie, N. Y. For measurement of astronomical photographs, etc. $1,000.

BIBLIOGRAPHY.

ROBERT FLETCHER, Army Medical Museum, Washington, D. C. For preparing and publishing the Index Medicus. $10,000.

EWALD FLÜGEL, Stanford University, Cal. For the preparation of a lexicon to the works of Chaucer. $7,500.

Herbert Putnam, Washington, D. C. For preparing and publishing a handbook of learned societies. $5.000.

BOTANY.

Desert Botanical Laboratory. Frederick V. Coville, Washington, D. C., and D. T. MacDougal, New York, N. Y., advisory committee. $5,000.

Burton E. Livingston, University of Chicago, Chicago, Ill. For investigations of the relations of desert plants to soil moisture and to evaporation. $400.

E. W. Olive, University of Wisconsin, Madison. For researches on the cytology of certain lower plants. $1,000.

V. M. Spalding, Tucson, Arizona. For investigation of absorption and transpiration of water by desert shrubs. $600.

CHEMISTRY..

John J. Abel, Johns Hopkins University, Baltimore, Md. For study of the chemical composition of the secretion of the supra-renal gland. $500.

Wilder D. Bancroft, Cornell University, Ithaca, N. Y. For a systematic chemical study of alloys. $500.

Chas. Baskerville, College of the City of New York, New York City. For investigations of the rare earths. $1,000.

Gregory T. Baxter, Cambridge, Mass. For research upon the atomic weight of manganese. $500.

Moses Gomberg and Lee H. Cone, Ann Arbor, Mich. For study of triphenylmethyl and analogous compounds. $500.

H. C. Jones, Johns Hopkins University, Baltimore, Md. For investigations in physical chemistry. $1,000.

W. L. Miller, University of Toronto, Toronto, Canada. For the study of electric migrations in solutions of weak acids. $500.

H. N. Morse, Johns Hopkins University, Baltimore, Md. For development of a method for the measurement of osmotic pressure. $1,500.

A. A. Noyes, Massachusetts Institute of Technology. For researches upon: (1) Electrical conductivity of salts in aqueous solution at high temperatures; (2) Ionization of weak acids and bases and hydrolysis of their salts in aqueous solution at high temperatures; (3) Transference determinations in aqueous solutions of acids. $1,000.

Thomas B. Osborn, New Haven, Conn. For research on chemical substances yielded by proteids of the wheat kernel when decomposed by acids. $1,500.

Theodore W. Richards, Harvard University, Cambridge, Mass. For investigation of the value of atomic weights, etc. $2,500.

Henry S. Washington, Locust, N. J. For the chemical investigation of igneous rocks. $1,200.

ENGINEERING.

W. F. Durand, Stanford University, California. For experiments on ship resistance and propulsion. $4,120.

W. F. M. Goss, Purdue University, Lafayette, Ind. For a research to determine the value of high steam pressures in locomotive service. $5,000.

EXPERIMENTAL PHONETICS.

E. W. Scripture, Yale University, New Haven, Conn. For researches in experimental phonetics. $2,700.

GEOLOGY.

T. C. Chamberlin, University of Chicago, Chicago, Ill. For study of fundamental principles of geology. $6,000.

Bailey Willis, U. S. Geological Survey, Washington, D. C. For geological exploration in eastern China. $12,000.

GEOPHYSICS.

Frank D. Adams, McGill University, Montreal, Canada. For investigation on flow of rocks. $1,500.

G. K. Gilbert, Washington, D. C. For preparing plans for investigating subterranean temperatures. $1,000.

HISTORY.

Annie Heloise Abel, New Haven, Conn. For investigating the early Indian policy of the United States. $150.

William Wirt Howe, New Orleans, La. For preliminary inquiry into the subject of an investigation on legal history and comparative jurisprudence. $1,000.

MATHEMATICS.

Derrick N. Lehmer, Berkeley, Cal. For pay of assistants to make the entries in a table of smallest divisors. $500.

E. J. Wilczynski, Berkeley, Cal. For investigation of ruled surfaces, etc. $1,800.

PALEONTOLOGY.

Oliver P. Hay, American Museum of Natural History, New York, N. Y. For monographing the fossil chelonia of North America. $3.000.

G. R. Wieland, Yale University, New Haven, Conn. For continuation of researches on living and fossil cycads, and illustration of memoir on the structure of the latter. $2,300.

PHYSICS.

S. J. Barnett, Stanford University, Cal. For research on the electric displacement induced in a certain dielectric by motion in a magnetic field. $250.

William Campbell, Columbia University, New York, N. Y. For research on the heat treatment of some high-carbon steels. $1,500.

H. S. Carhart, University of Michigan, Ann Arbor, Mich. For preparation of material for standard cells, etc. $500.

C. D. Child, Colgate University, Hamilton, N. Y. For investigation of the ionization in the neighborhood of a mercury arc in a vacuum. $50.

Henry Crew, Evanston, Ill. For study of certain arc spectra. $1,000.

George E. Hale, Mount Wilson, Cal. For experiments on the use of fused quartz for the construction of optical mirrors. $3,000.

E. Percival Lewis, University of California, Berkeley, Cal. To investigate vacuum-tube spectra of gases and vapors. $500.

A. A. Michelson, University of Chicago, Chicago, Ill. For aid in ruling diffraction gratings. $1,500.

R. W. Wood, Johns Hopkins University, Baltimore, Md. For research, chiefly on the theory of light. $500.

PHYSIOLOGY.

W. O. Atwater, Wesleyan University, Middletown, Conn. For investigations in nutrition. $7,000.

Russell H. Chittenden, Sheffield Scientific School of Yale University, New Haven, Conn. For a study of the minimal proteid requirement of the healthy man. $1,500.

Arthur Gamgee, Montreux, Switzerland. For preparing a report on the physiology of nutrition. $6,500.

Hideyo Noguchi, University of Pennsylvania, Philadelphia, Pa. For continuation of the studies on snake venoms. $1,700.

Edward T. Reichert and Amos P. Brown, University of Pennsylvania, Philadelphia, Pa. For research on the crystallography of hæmoglobin. $1,000.

ZOOLOGY.

A. J. Carlson, Stanford University, Cal. For research on the physiology of the invertebrate heart. $100.

W. E. Castle and E. L. Mark, Museum of Comparative Zoology, Cambridge, Mass. For experimental studies in heredity. $500.

Henry E. Crampton, Columbia University, New York, N. Y. For determining the laws of variation and inheritance of certain lepidoptera. $500.

J. E. Duerden, University of Michigan, Ann Arbor, Mich. For continuation of investigation on the morphology and development of recent and fossil corals. $1,500.

Carl H. Eigenmann, University of Indiana, Bloomington, Ind. For investigation of blind fishes in Cuba. $1,000.

L. O. Howard, Department of Agriculture, Washington, D. C. For preparing a report on American mosquitoes. $2,500.

C. E. McClung, Kansas University, Lawrence, Kans. For making a comparative study of the spermatogenesis of insects, etc. $500.

William Patten, Hanover, N. H. For studies relating to the origin of vertebrates. $500.

Raymond Pearl, University of Michigan, Ann Arbor, Mich. For an investigation by statistical methods of correlation in variation. $500.

W. L. Tower, University of Chicago, Chicago, Ill. For an investigation of the potato beetles of Mexico. $445.

H. V. Wilson, University of North Carolina, Chapel Hill, N. C. For morphology and classification of deep-sea sponges. $1,000.

N. Yatsu, Columbia University, New York. For experimental studies of the Nemertine egg. $300.

Marine Biological Laboratory, Woods Hole, Mass. J. Blakely Hoar, treasurer. For maintenance of 20 tables. $10,000.

Naples Zoological Station, Naples, Italy. For maintenance of two tables. $1,000.

RESEARCH ASSISTANTS.

The policy in relation to research assistants, as outlined in Year Book No. 2, pp. xlvii–xlviii, was continued, and the persons below named conducted investigations in the branches of science indicated:

C. E. Allen, Madison, Wis. For a study of the homologies of the gametophyte and sporophyte, etc. $1,000.

A. F. Blakeslee, Cambridge, Mass. For an investigation of sexuality in the lower fungi. $1,000.

W. W. Coblentz, Cornell University, Ithaca, N. Y. For investigating infra-red emission and absorption spectra. $1,000.

A. L. Dean, New Haven, Conn. For investigating the proteolytic enzymes of plants. $1,000.

L. E. Dickson, University of Chicago, Chicago, Ill. For certain mathematical investigations. $1,000.

H. W. Doughty, Johns Hopkins University, Baltimore, Md. For an investigation of camphoric acid, under the direction of Professor A. A. Noyes. $1,000.

C. B. Farrar, Towson, Md. For psychological experiments at the Sheppard and Enoch Pratt Hospital. $1,000.

William Jones, New York, N. Y. For investigating the religion of the central group of Algonkian Indians. $1,000.

A. S. King, Bonn, Germany. For the production and study of emission spectra at high temperatures. $1,000.

P. A. Levene, New York, N. Y. For researches along the line of determining points in the constitution of proteids. $1,000.

R. S. Lillie, University of Nebraska, Lincoln, Nebr. For a study of the relation of ions to the various forms of protoplasmic movement. $1,000.

G. D. Louderback, San Francisco, Cal. For a study of the glaucophane and associated schists. $1,300.

F. E. Lutz, Bloomsburg, Pa. For study of organic evolution at Station for Experimental Evolution, Cold Spring Harbor, Long Island. $1,000.

U. B. Philips, University of Wisconsin, Madison, Wis. For a study of the influence of plantation in political and social history of the south. $300.

F. E. Ross, Washington, D. C. For astronomical investigation, under Professor Simon Newcomb.

L. S. Rowe, University of Pennsylvania, Philadelphia, Pa. For a study of Mexican constitutional system. $1,200.

P. E. Sargent, Cambridge, Mass. For an investigation in comparative neurology. $1,000.

G. W. Scott, Philadelphia, Pa. For a study of private claims against foreign nations to which the United States has been a party. $1,200.

E. S. Shepherd, Cornell University, Ithaca, N. Y. For a systematic study of alloys, with especial reference to brasses and bronzes. $1,000.

G. H. Shull, University of Chicago, Chicago, Ill. For an investigation in heredity, hybridization, variation, mutation, etc. $1,000.

Mary Roberts Smith, Palo Alto, Cal. For studying the history and social conditions of the Chinese immigration in California. $1,000.

Nettie M. Stevens, Bryn Mawr College, Bryn Mawr, Pa. For an investigation of problems relating to sex determination, etc. $1,000.

J. B. Whitehead, Johns Hopkins University, Baltimore, Md. For study of the magnetic effect of electrical displacement. $1,200.

E. J. Wilczynski, Berkeley, Cal. For an investigation of ruled surfaces, etc. $1,800.

Fritz Zerban, Munich, Germany. For an investigation of rare earths, under the direction of Professor C. Baskerville. $1,000.

PUBLICATIONS.

The following publications have been issued during the year:

Year Book No. 2, 1903. Octavo, 371 pages.

'Report of Committee on Southern and Solar Observatories.' Extracted from Year Book No. 2. Octavo, 170 pages.

'Desert Botanical Laboratory of Carnegie Institution.' Publication No. 6. By F. V. Coville and D. T. MacDougal. Octavo, 58 pages 29 plates.

'New Method of Determining Compressibility.' Publication No. 7. By T. W. Richards and W. N. Stull. Octavo, 45 pages, 5 text figures.

'Contributions to Stellar Statistics.' First paper. On the Position of the Galactic and other Planes toward which the Stars tend to Crowd. Publication No. 10. By Simon Newcomb. Quarto, 30 pages.

'Production of Sex in Human Offspring.' Publication No. 11. By Simon Newcomb. Octavo, 34 pages.

'The Action of Snake Venom upon Cold Blooded Animals.' Publication No. 12. By Hideyo Noguchi. Octavo, 16 pages.

'The Influence of Grenville on Pitt's Foreign Policy, 1787–1898.' Publication No. 13. By E. D. Adams. Octavo, 79 pages.

'Guide to the Archives of the Government at Washington.' Publication No. 14. Octavo, 250 pages.

'Fecundation in Plants.' Publication No. 15. By D. M. Mottier. Octavo, 187 pages.

'Contributions to the Study of the Behavior of the Lower Organisms.' Publication No. 16. By H. S. Jennings. Octavo, 256 pages.

'Traditions of the Arikara.' Publication No. 17. By G. A. Dorsey. Octavo, 202 pages.

'Researches on North American Acridiidæ.' Publication No. 18. By Albert P. Morse. Octavo, 56 pages, 8 plates.

The following are in press:

'Coloration in *Polistes*.' Publication No. 19. By Wilhelmine M. Enteman. Octavo, 88 pages, 6 colored plates.

'The Coral *Siderastræa radians*.' Publication No. 20. By J. E. Duerden. Quarto, 144 pages, 11 plates.

'Mythology of the Wichita.' Publication No. 21. By G. A. Dorsey. Octavo, 353 pages.

'The Waterlilies.' Publication No. 22. By H. S. Conard. Quarto, 280 pages, 30 plates.

'Bacteria in Relation to Plant Diseases.' By Erwin F. Smith. Quarto.

'Explorations in Turkestan.' By R. Pumpelly, R. W. Pumpelly, W. M. Davis and Ellsworth Huntington. Quarto.

'Collected Mathematical Works of G. W. Hill.' It is estimated that these works will make four quarto volumes. Volume I. is in type.

'Catalogue of Double Stars.' By S. W. Burnham. 350 pages in type.

The following are authorized:

'Evolution, Racial and Habitudinal, controlled by segregation.' By J. T. Gulick.

'Chimera—a Memoir on the Embryology of Primitive Fishes.' By Bashford Dean. Manuscript not received, but plates are prepared.

'Bibliographic Index of North American Fungi.' By W. G. Farlow. Will make five octavo volumes. 250 pages in type.

'Results of Investigations of Poison of Serpents.' By Drs. Simon Flexner and Hideyo Noguchi. Manuscript not received.

'Heredity of Coat Characters in Guinea Pigs and Rabbits.' By W. E. Castle.

'Mutants and Hybrids of the Oenotheras.' By D. T. MacDougal.

'Astronomical Manuscript.' By C. H. F. Peters.

'Memoir on Fossil Cycads.' By G. R. Wieland.

'Description of the New Oxygen Apparatus Accessory to the Calorimeter.' By W. O. Atwater.

'Rotation of the Sun as Determined from Motion of the Calcium Flocculi.' By G. E. Hale and Philip Fox.

LIST OF ACCOMPANYING PAPERS.

'A Study of the Conditions for Solar Research at Mount Wilson, California.' By George E. Hale.

'The Southern Observatory Project.' By Lewis Boss.

'Methods for Promoting Research in the Exact Sciences.' By Dr. Simon Newcomb, Professor H. H. Turner, Karl Pearson, Lord Rayleigh, G. H. Darwin, Arthur Schuster, Edward C. Pickering.

'Fundamental Problems of Geology.' By T. C. Chamberlin.

'Plans for Obtaining Subterranean Temperatures.' By G. K. Gilbert.

'Proposed Magnetic Survey of the North Pacific Ocean.' By L. A. Bauer and G. W. Littlehales, Capt. E. W. Creak, Superintendent O. H. Tittmann.

'Geological Research in Eastern Asia.' By Bailey Willis.

MATHEMATICAL PROGRESS IN AMERICA.*

In the remarks that follow I shall limit myself to a brief consideration of progress in pure mathematics. This I may do the more appropriately inasmuch as one of my predecessors, Professor R. S. Woodward, at the annual meeting of 1899 gave an account of the advances made in applied mathematics during the nineteenth century. In his address, which was published in the *Bulletin of the American Mathematical Society*, for January, 1900, is included a description of the more important advances made by Americans in the field of applied mathematics.

In tracing the development of pure mathematics in America it seems convenient to recognize three periods. The first period extends from colonial days up to the establishment of the Johns Hopkins University in 1876; the second period extends from the establishment of the Johns Hopkins University up to 1891, when the New York Mathematical Society took on a national character and began the publication of its *Bulletin;* the third period extends from 1891 up to the present time.

The most valuable source from which the general reader may secure information in regard to the first period mentioned above is a work entitled 'The Teaching and History of Mathematics in the United States.' This work, written by Professor Florian Cajori, was published in 1890 by the United States Bureau of Education.†

Before the founding of the Johns Hopkins University there was almost no attempt made to prosecute or even to stimulate in a systematic manner research in the field of pure mathematics. Such mathematical journals as were published were scientifically of little importance and as a

* Presidential address delivered at the annual meeting of the American Mathematical Society, December 29, 1904.

† Circular of Information No. 3, 1890.

rule lived but a year or two. The only exception that we need mention was the *Analyst* edited by Dr. J. E. Hendricks and published at Des Moines, Ia., from 1874 to 1883; and the publication of this journal began practically at the close of the period referred to above.

However, there was a certain number of men, for the most part self trained, who were eminent among their fellows for their mathematical scholarship, their influence upon the younger men with whom they came in contact, and their capacity for independent investigation. Of these the most conspicuous were Adrain, Bowditch and Peirce. Adrain is known for his apparently independent discovery of the law of distribution of errors; Bowditch is known for his translation of Laplace's 'Mécanique Celeste' accompanied by a commentary of his own; and Peirce is now known chiefly for his classical memoir, 'Linear Associative Algebra,' which was the first important research made by an American in the field of pure mathematics.

With the arrival of Professor Sylvester at Baltimore and the establishment of the *American Journal of Mathematics*, began the systematic encouragement of mathematical research in America. Professor Sylvester drew about him a body of deeply interested students, and through his own untiring efforts and his inspiring personality a most powerful stimulus was exerted upon the mathematical activities of all who were associated with him. His work here, however, continued only six years. In 1884 he returned to England to take the chair offered to him by Oxford University.

The first ten volumes of the *American Journal of Mathematics*, published from 1878 to 1888, contained papers contributed by about ninety different writers. Of these thirty were mathematicians of foreign countries. Almost one third of the remaining sixty were pupils of Professor Sylvester; the others were mathematicians some of whom had come under the influence of Benjamin Peirce, some of whom had been students at German universities and some of whom were in large degree self-trained. They seemed to need only the opportunity of publication and a circle of readers to induce them to rush into print. In fact, several of them had already sent papers abroad for publication in foreign journals. Among the contributors to early volumes of the *American Journal of Mathematics* we should especially mention Newcomb, Hill, Gibbs, C. S. Peirce, Johnson, McClintock, Story, Stringham, Craig and Franklin.

We must at this point give some attention to the rapidly increasing influence of the German universities upon American mathematical activity. For some time a considerable number of young Americans, attracted by the superior opportunities offered by the German universities, had been going abroad for the study of the more advanced branches of mathematics. The lectures of Professor Klein, of Göttingen, were in particular the Mecca sought by young Americans in search of mathematical knowledge. I think that it may be said safely that at the present time ten per cent. of the members of the American Mathematical Society have received the doctorate from German universities, and that twenty per cent. of its members have for some time at least pursued mathematical studies in Germany. It is not surprising that as a result a large portion of the American mathematical output shows evidence of direct German influence if not of direct German inspiration.

In 1883, as we have already indicated, the publication of the *Analyst* was discontinued. In the following year a new journal, the *Annals of Mathematics*, under the editorial management of Professor Stone, of the University of Virginia, began publication. This journal was of a somewhat less ambitious character than the *American Journal of Mathematics*. It is interesting to note in connection with it that to a considerable extent its pages were given to papers on applied mathematics. In 1899 the *Annals* passed into the editorial control of the Mathematical Department of Harvard University. Since that time it has been largely expository or didactic. It has not sought to publish new investigations of an extended character, although it has not hesitated to publish brief papers announcing new results.

Let us now turn to a brief review of the history of the society which brings us together on this occasion.

At a meeting held November 24, 1888, six members of the department of mathematics of Columbia University formed a society, which was to meet monthly for the purpose of discussing mathematical topics and reading papers of mathematical interest. At the meeting held a month later they resolved to call their society the New York Mathematical Society and to invite the cooperation of all persons living in or near New York city who might be professionally interested in mathematics. By the end of the year 1889 the membership of the society had increased to sixteen. By the end of 1890 it had increased to twenty-two.

At the meeting held in December, 1890, the first president of the society, Professor J. H. Van Amringe, retired from office, and Dr. Emory McClintock was elected his successor. At the same meeting it was proposed that the society publish a mathematical bulletin. The officers of the society a month later made a report in which they recommended that the bulletin, if established, should not seek to enter into competition with existing mathematical journals, but that it should be devoted primarily to historical and critical articles, accounts of advances in different branches of mathematics, reviews of important new publications, and general mathematical news and intelligence. They showed at the same time that the expense connected with such a publication would necessitate an extension of the membership of the society together with an increase in the annual dues. It was suggested, accordingly, that a general circular be issued, describing the aims of the society and inviting suitable persons to become members.

After hearing the report, the society authorized the secretary to undertake a preliminary correspondence with a few of the principal mathematicians of the country with a view to determining whether their favor and assistance might be secured for the proposed enterprise. A month later the secretary reported that he had received favorable responses from Professor Simon Newcomb, Professor W. Woolsey Johnson, Professor Thomas Craig and Professor H. B. Fine. As a result of these favorable responses the society decided to approve and adopt the plan recommended by the officers of the society for the extension of its membership and for the publication of a historical and critical review of pure and applied mathematics. A circular letter of invitation such as had been recommended was issued shortly thereafter. The proposals which it contained seemed to meet with general favor, and by June, 1891, the membership of the society had increased to one hundred and seventy-four. The first number of the *Bulletin* was issued in October, 1891. Its appearance seemed to increase the interest already excited, and by the summer of 1892 the membership of the society had risen to two hundred and twenty-seven.

Professor Klein and Professor Study, who visited the United States in 1893 for the purpose of attending the International

Mathematical Congress held in Chicago, were present at the meeting of the society held in October of that year. They both delivered addresses before the society and expressed great interest in its work.

By the spring of 1894 it was felt generally that the operations of the society had assumed a national character, and a new constitution was adopted providing for a change of name from the New York Mathematical Society to the American Mathematical Society. In June of the same year the society undertook to provide means for the publication of the papers read at the Chicago congress the preceding year, and arrangements were made for holding a 'summer meeting' in conjunction with the Brooklyn meeting of the American Association for the Advancement of Science.

At the annual meeting held December, 1894, Dr. Emory McClintock retired from the presidency, being succeeded by Dr. George W. Hill. At this meeting Dr. McClintock delivered an address which was published in the *Bulletin* for January, 1895. It was entitled 'The Past and Future of the Society' and contains an account of the society during the first six years of its existence. Upon the occasion of Dr. McClintock's retirement from the presidency the society adopted a resolution expressing its appreciation of the great services that he had rendered while presiding officer, and its recognition of the fact that largely to his initiative were due the broadening of organization and extension of membership which made the society properly representative of the mathematical interests of America.

The next event of special importance in the history of the society occurred in 1896. Immediately after the summer meeting of that year, which was held in connection with the Buffalo meeting of the American Association for the Advancement of Science, the society's first 'colloquium' took place. Interesting and instructive courses of lectures were delivered by Professors Bôcher and Pierpont, and at the close of the colloquium those participating in it recommended that similar arrangements be made periodically in connection with subsequent summer meetings. In the same year, for the regular October meeting of the society was substituted a special meeting at Princeton in connection with the sesquicentennial celebration of Princeton University. At that meeting the society was addressed by Professor Klein and Professor J. J. Thomson.

In the spring of 1897 the Chicago section of the society was established. At the same time, it was determined to replace the meetings held monthly in New York by meetings held four times a year at intervals of two months. The summer meeting of 1897 was held at Toronto in connection with the meeting of the British Association for the Advancement of Science. It was attended by a number of visitors from Great Britain, among whom were Professors Forsyth, Greenhill and Henrici.

A colloquium was held in the summer of 1898 at Harvard University. There was much discussion among those attending it in regard to the need of larger and better facilities for the publication of mathematical researches. The following winter the society proposed to the Johns Hopkins University that the *American Journal of Mathematics* should be enlarged and issued more frequently, and that the society should be given a share in the editorial control of the *Journal*. The society was, however, unable to reach an agreement with the Johns Hopkins University, and in April, 1899, the society determined to establish an organ of its own for the publication of the more important original papers presented at its meetings. The financial resources of the society were not sufficient to carry on the work already begun and at the same time to provide for the new publication; but it was found possible to secure assistance from ten colleges and universities which promised to join in support of the undertaking. The new publication, known as the *Transactions of the American Mathematical Society,* made its first appearance in January, 1900.

Simultaneously with the meeting held by the society in October, 1899, was held the first meeting of the newly organized American Physical Society. On this occasion the Mathematical Society met with the Physical Society for the purpose of listening to the address of President H. A. Rowland of the Physical Society. Again, two months later, on the occasion of the annual meeting of the American Mathematical Society, the two societies met in joint session for the purpose of listening to the presidential address of Professor R. S. Woodward, of the Mathematical Society. In this connection it may be of interest to recall that the organization of the American Physical Society was modelled, in a general way, after that of the Mathematical Society. The two societies have many members in common and have uninterruptedly enjoyed the most cordial relations.

In 1901 the Mathematical Society was compelled to turn its attention to the care of its rapidly growing library. An agreement was made with Columbia University whereby that institution undertook to bind and catalogue the books belonging to the society and to make the arrangements necessary for the loan of the books to members. In return therefor the university is able to make use of the society's collection in the way of a reference library. In October, 1901, the American Physical Society met again in joint session with the Mathematical Society for the purpose of listening to a paper by Professor Hadamard, who was visiting America as a delegate to Yale's bicentennial celebration.

In May, 1902, the San Francisco section of the society was established. In December of the same year Professor E. H. Moore delivered his address as president of the society. Very largely as a result of this address, the influence of the society was exerted to bring about the organization of associations of teachers of mathematics with a view to improving the methods of mathematical teaching. The Association of Teachers of Mathematics in New England was organized in April, 1903. The Association of Teachers of Mathematics in the Middle States and Maryland was organized in November of the same year. Several similar associations have been organized more recently in various sections of the country.

Two events have occurred during the year now closing which are of sufficient importance to deserve mention here. One is the determination of the society to publish in book form the mathematical lectures delivered at the colloquium held in Boston in 1903. The other is the meeting held last summer in connection with the International Scientific Congress at St. Louis.

In connection with this brief outline of the society's history it is, perhaps, desirable to indicate in figures the growth of the society and its work. During the past ten years the membership of the society has doubled, rising from about 250 in 1894 to almost 500 at the present time. Ten years ago the number of papers presented each year at the meetings of the society was in the neighborhood of 30, of which about a dozen were subsequently published. During the year 1903–04 the number of papers presented at meetings of the society was 154 and the number of papers published by members after presentation was 85. In January, 1902, when the present administration of the society's library began the number of volumes in the library was 121, while at present it is almost 2,000.

If any one wishes to have pass before him in review the scientific activities of the Mathematical Society he has only to consult two pamphlets issued a few months ago. I refer to the general index to the first thirteen volumes of the society's *Bulletin,* compiled by Dr. Emilie N. Martin and to the index to the first five volumes of the *Transactions* compiled under the direction of the editor-in-chief of the *Transactions.* The American Mathematical Society to-day serves to bring together into a harmonious whole all the mathematical activities of America. It is only infrequently that a mathematical paper of importance is published without having been read previously at a meeting of the society. To give an account of the present condition of the society is practically the same as to give an account of the present condition of American mathematics.

Nothwithstanding the great progress recently made in America by our science, we are far from being in a position that we can regard as entirely satisfactory. We have only to look about us in order to see that improvement is not only possible but necessary in almost every direction.

In the first place, the most pressing demand, perhaps, is that those engaged in lecturing on the more advanced branches of mathematics at American universities should be given greater opportunities for private study and research. At present the time of almost every university professor is taken up to a very large extent with administrative matters connected with the care of comparatively young students. Discussions in regard to admission requirements, the courses of study, discipline and the control of athletics absorb a large part of the time and strength of the faculty of every university. It is possible that this situation will in the course of the next twenty years be greatly relieved by a change, which many consider is already in sight. This change is nothing more or less than the relegation of the first two years of the ordinary college course to the secondary school and the establishment of university courses that will begin with the present third year of the college. The progress made in recent years by the public high schools makes it plain that before long they will be able without difficulty to duplicate the first two years of the present college course, and as more highly trained teachers take up the work of these schools there is no doubt that there will be a constantly increasing effort to take up this work. If this be done, not only will the condition of the secondary schools be greatly improved, but our university teachers will secure the relief so greatly needed for the advancement of the highest interests of our science.

In the second place, it is of the greatest importance that the mathematical journals already established in this country—the *Bulletin of the American Mathematical Society,* the *Annals of Mathematics,* the *American Journal of Mathematics* and the *Transactions of the American Mathematical Society*—should all be encouraged and assisted to extend their influence and increase their efficiency. It is the duty of every member of the society to interest himself to the greatest possible extent in the work of each of these journals. It is important also that we should strive to secure for these journals more adequate financial support. In other countries it is not unusual for the government itself to give financial support to such publications.

In the third place, we must have improved methods of teaching, better textbooks and more good treatises on advanced subjects. The members of the society, working as individuals, can do much along these lines. The society as a whole, let us hope, will some day be able to render important assistance in the publication of mathematical works of the best type. It is quite possible that in some cases direct translation from foreign languages would be highly beneficial. Many of the most important mathematical works published in German, French or Italian are at once translated so as to be accessible in all three of these languages. Is there no lesson in this for us? An English translation of the new 'Encyclopedia of Mathematics' would probably do much to spread throughout this land of seventy-five million inhabitants a knowledge of and an interest in advanced mathematics.

Finally, we must not relax our efforts to increase and improve the opportunities offered those interested in mathematics to meet one another for the purpose of exchanging their views upon mathematical topics. The society must encourage, even to a greater extent than hitherto, the holding of mathematical colloquiums, sectional meetings, largely attended general meetings, and international congresses.

Thomas S. Fiske.

THE AMERICAN MATHEMATICAL SOCIETY.

The eleventh annual meeting of the American Mathematical Society was held at Columbia University on Thursday and Friday, December 29–30. The attendance at the several sessions included forty-nine members. The retiring president, Professor T. S. Fiske, occupied the chair. The council announced the election of the following persons to membership in the society: Mr. G. I. Gavett, Stanford University; Mr. M. E. Graber, Heidelberg University, Tiffin, Ohio; Mr. E. B. Lytle, University of Illinois; Professor R. E. Moritz, University of Washington; Dr. B. L. Newkirk, University of California. Fourteen applications for membership were received. A committee was appointed to arrange for the summer meeting.

At the opening of the afternoon session on Thursday, President Fiske delivered his retiring address, the subject being 'Mathematical Progress in America.' The address, published in the present issue of Science, dealt with the general development of mathematics in this country and especially with the powerful influence exerted by the society since its organization in 1888. Professor Fiske was himself one of the founders of the society, which owes much to his initiative and valuable services as secretary, editor of the *Bulletin* and the *Transactions* and in other official capacities culminating in the presidential office.

At the annual election, which closed on Friday morning, the following officers and members of the council were chosen:

President—W. F. Osgood.

Vice-Presidents—E. W. Brown and James Pierpont.

Secretary—F. N. Cole.

Treasurer—W. S. Dennett.

Librarian—D. E. Smith.

Committee of Publication—F. N. Cole, Alexander Ziwet, D. E. Smith.

Members of the Council to serve until December, 1907—E. R. Hedrick, T. F. Holgate, E. O. Lovett, L. A. Wait.

An informal dinner on Thursday evening, attended by about thirty-five of the members, added much to the pleasure of the meeting.

The *Annual Register* of the society, this year a book of 76 pages, including the catalogue of the library, has just been published. The total membership is now 473, of whom 32 are life members. The number of papers presented during the year 1904 was 118. The treasurer's report shows a balance of $3,884.28 on hand December 27, 1904. The library now contains over 2,000 volumes.

The following papers were read at the annual meeting:

Max Mason: 'The doubly periodic solutions of Poisson's equation in the plane.'

Virgil Snyder: 'On the forms of sextic scrolls having no rectilinear directrix.'

A. B. Coble: 'Some applications of a theorem in the theory of forms.'

L. E. Dickson: 'The group of a tactical configuration.'

T. S. Fiske: Presidential address, 'Mathematical progress in America.'

Maurice Fréchet: 'Sur les opérations linéaires (deuxième note).'

F. Morley: 'On an inversive relation between five points of a plane.'

J. E. Wright: 'Application of the theory of continuous groups to a certain differential equation.'

Edward Kasner: 'Geometry of point correspondences: osculating homographies.'

C. H. Sisam: 'On septic scrolls.'

E. V. Huntington: 'Note on definitions of groups, abelian groups, and fields.'

E. V. Huntington: 'A set of postulates for ordinary complex algebra.'

Burke Smith: 'On the deformation of surfaces of translation.'

L. E. Dickson: 'A general theorem on algebraic numbers.'

A. B. Coble: 'The similar projective groups of a cubic space curve and a quadric surface.'

E. H. Moore: 'On a definition of abstract groups.'

The Chicago Section of the society met at Chicago, on December 30–31. The next meeting of the society will be held on February 25. The San Francisco Section will meet on the same date.

F. N. Cole,
Secretary.

THE GEOLOGICAL SOCIETY OF AMERICA.

The seventeenth annual meeting of the Geological Society of America was held at the University of Pennsylvania, Philadelphia, December 29–31, 1904, under the presidency of Professor John C. Branner, of Stanford University. Sixty-one papers, divided among eight branches of the science, were presented for reading, and about one hundred members of the society were in attendance, making the convention one of the largest in its history. The report of the council for the year 1904 shows that in all respects the affairs of the society are in a highly satisfactory condition. The net active membership of the society was reported as being 259, and 15 new members were elected at the Philadelphia meeting. During the past year, five members have been removed by death, Professor C. E. Beecher, J. B. Hatcher, Henry McCalley, W. H. Pettee and Charles Schäffer. Memorials of these members were read at the first session of the Philadelphia meeting.

The report of the treasurer showed that the society had a balance in the treasury, December 1, 1904, of $1,973.68 and invested funds amounting to $8,300. The volume of the *Bulletin* of the society comprises 636 pages of text, with 75 illustrations, the articles being divided among nine branches of the science, of which stratigraphic geology occupies about one half. The library of the society, which is deposited with the Case School of Applied Science in Cleveland, now comprises some 2,600 numbers, of which 1,400 are bound volumes.

Professor Branner chose as the subject of his presidential address, 'Geological and Geographical Studies on the Northeast Coast of Brazil,' and illustrated his paper by means of numerous photographs and charts. The most peculiar feature of this coast is the series of hardened sandspits occurring at the mouths of most of the rivers. These spits consist of quartzose sand which has been cemented together into a hard solid rock by means of calcium carbonate brought down in solution by the rivers and precipitated by contact with the waters of the ocean, which here possess a high degree of salinity. This hardening extends to a depth of several feet and, in many instances, has been of great economic importance through the formation thereby of natural breakwaters, forming safe harbors, as at Pernambuco. The spits contain many fossils, all of which are of living species. A second coast feature of importance is the series of coral reefs which alternate or which are associated with the sandspits in certain localities. These reefs seem to be comparatively thin, but many of them are wide. That the coast has remained stationary for a considerable time is indicated by the fact that these reefs reach to the upper limit of coral growth, where they show broad areas of dead coral within the fringe of living animals.

In the restricted space of a summary report like the present it will not be possible to do more than briefly outline the contents of the more important of the 43 papers which were actually read, leaving out of account those which were read only by title.

Dr. Robert Bell, director of the Geological Survey of Canada, read a somewhat detailed paper on the geology of the region in the vicinity of the Great Slave Lake, and illustrated his remarks by maps and sections made for the Canadian Survey.

Professor E. R. Cumings, of the Indiana State University, discussed the development and morphology of *Fenestella*, and showed that this Devonian bryozoa is related genetically to the cyclostomata. In a paper concerning new evidences of the geographical differences of fossil faunas of the same age, Professor H. S. Williams, of Cornell University, stated that extended study of the Devonian rocks of the eastern United States pointed to the conclusion that geological faunas once thoroughly established probably possessed a geological range far greater than is indicated by the actual range in any particular section.

The petrographic and economic papers were introduced by Professor James F. Kemp, of Columbia University, in a paper detailing observations made along the garnet contact zones and associated copper ores at San José, Tamaulipas, Mexico. These contact zones are the result of the action of an intruded bed of andesite upon the surrounding Cretaceous limestone. Geologically the formation of garnets has been the most important feature and has resulted from the rearrangement and recrystallization of the materials present in the limestone. The chalcopyrite, which is the important ore, is a later phase of the contact phenomena. In another communication Professor Kemp described his method of 'Geological Bookkeeping,' which is a system of taking notes in the field and of locating the observations upon the field map, based upon a series of definite and invariably subdividing squares. This leads to a compilation book in which the observations of scattered seasons are entered upon pages which correspond in their enumeration to the series of squares on the field map. It is believed that the system possesses advantages in affording permanency and intelligibility of records even though the latter be made at widely diverse times and by different individuals.

In a paper on the occurrence and distribution of celestite-bearing rocks, Professor E. H. Kraus, of Michigan State University, stated that the mineral occurs widely throughout central New York and southern California. The percolating waters have leached out the crystals to a considerable extent, forming the so-called 'vermicular' limestones of New York and the 'gashed' and 'acicular' dolomites of Michigan. Precipitation of the material from these waters is the source of the large deposits of celestite which occur at Put-In Bay, the Maybee Quarry, Monroe County, Mich., and elsewhere.

Professor T. C. Hopkins, of Syracuse University, described the closely crystalline, fine, fossiliferous, metamorphic limestones of central and southern California which contain the wonderful deposits of tourmaline and other gems which have been obtained within the past few years from

Eldorado County southward to the national boundary.

According to Dr. G. P. Merrill, of the National Museum, the so-called asbestos (fibrous serpentine) of the Thetford Mines, Canada, and elsewhere, fills cavities which were made by the shrinkage of the massive serpentine in which the fibrous material occurs, and he advances arguments to prove that the filling process is due to crystallization from the walls of the cavities inward.

Messrs. Ralph Arnold and A. M. Strong, of the California State University, described at length the crystalline rocks of the San Gabriel Mountains near Pasadena, Cal. The last of the petrographical papers was by Dr. G. M. Murgoci, of Bucharest, Roumania, and concerned the origin of the peculiar rock known as riebeckite granite, suggesting that the change from normal granite was due to heavy pressure combined with motion.

Five papers on physiographical geology were presented, three of which were read in full. Professor N. M. Fenneman, of the University of Wisconsin, in a paper on the control of the form of contact surfaces by marine denudation, laid down the principles that the nature of a surface of unconformable contact between strata is determined by two factors: (1) the topography of the early land surface, and (2) cliff erosion during submergence. The first element would preserve the former land-surfaces in the subsequent beds, while the dominance of the second element would make the contact surface in every case a plane.

Professor R. S. Tarr, of Cornell University, described some drainage features of southern central New York showing the relation of the pre-glacial valleys to the present surface. In many instances along the divide between the Susquehanna and St. Lawrence drainage system there is a condition of lowered divides, across some of which, as in the Tioughnioga valley, east of Cortland, and Cayuta Creek valley, west and south of Van Etten, the present drainage passes. Three theories may be adduced to account for these phenomena: glacial erosion, erosion by ice-fed stream and head-water erosion during rejuvenation. Evidence from valley form, glacial deposits and hanging tributary valleys is presented to prove that these drainage features are in many cases, if not in all, due to changes of earlier date than the advance of the Wisconsin ice sheet. While the influence of possible earlier ice advances, of which no evidence has been found in this region, is not eliminated, the facts so far discovered favor the hypothesis of rejuvenation rather than of glacial action during earlier ice advance.

The next paper pertained to hanging valleys and was by Professor Israel C. Russell, of the University of Michigan. He recognizes four classes of such valleys, each of which contains several varieties. The author considers that too much stress has been laid upon the existence of lateral glaciated hanging valleys on the sides of glaciated troughs and he advances evidence to show that in certain instances at least such valleys are not due in a conspicuous manner to differentiation of glacial erosion. The study of glaciated hanging valleys is intimately connected with a still greater problem, namely, the origin of the leading features in the relief of such mountains as the Sierra Nevada range and the Cascades. There is good reason for thinking that these two ranges were deeply stream-sculptured prior to the glacial epoch.

Under the head of physical and structural geology twelve papers were read. Professor C. K. Leith, of the University of Wisconsin, discussed in masterly fashion the present state of knowledge of the subject of rock cleavage, with special reference to recent publications by Dr. Becker and himself. The author has devised a piece of apparatus which mechanically illustrates his theories in a remarkable manner. Professor E. H. Kraus, in a paper on the origin of the caves of the island of Put-In Bay, Lake Erie, stated that in all probability the folding of the Lower Helderberg limestone of the region was caused by hydration of anhydrite, since large deposits of gypsum have been encountered in sinking wells in the immediate vicinity. The increase in volume caused by such hydration may be as high as sixty per cent. and the energy developed in the process would be sufficient to account for the results observed. Subsequent leaching out of the gypsum by percolating waters would account for the existence of the caves, and the collapse of the roofs of the cavities would account for the step-like form of the ceiling.

Mountain growth and mountain structure was the subject of a communication from Mr. Bailey Willis, of the United States Geological Survey. The study of peneplains at various altitudes with reference to sea level, in North America and Eurasia, demonstrates that elevations of the earth's surface have resulted from deformation which produced warping of previously levelled-off surfaces. In general this process has been a recent one, post-Mesozoic in time, and it may be held that mountains are youthful features of the earth. The structures which have been discovered in mountain masses are such as are developed under a considerable load, and consequently at notable depths in the earth's mass. Study of the relation between structure and form leads to the conclusion that modern mountains are not the effects of the forces which produce the structure, a conclusion which cuts at the foundation of older systems of classification.

Professor Florence Bascom, of Bryn Mawr, brought out by means of detailed maps the nature of the formation and the structure of the Piedmont region of Pennsylvania, giving the results of extended field work carried on for the United States Geological Survey. Her paper was followed with one on the Piedmont of Maryland in correlation with that of Pennsylvania by Professor E. B. Mathews, of Johns Hopkins University. The latter author afterward read a paper on the Cockeysville marble, in which he gave the results of much very close field study by himself and W. J. Miller, of Baltimore, into the concrete problem in Piedmont structure, the area concerned occupying approximately 300 square miles and lying north of the city of Baltimore.

Mr. N. H. Darton, of the United States Geological Survey, in discussing overlap relations along the Rocky Mountain front range, described features which have been traced by him through Wyoming and Colorado into New Mexico, mainly for the purpose of correlating the different forms. He finds that the Paleozoic and Mesozoic rocks of the region present frequent variation in character, occurrence and varieties. In the course of his field work, Mr. Darton visited the Zuñi salt lake, forty miles north of the Indian pueblo of Zuñi. At this locality there is in the plain a circular depression about a mile in diameter, containing a salt lake and two cinder cones. The depth of the depression is about 200 feet and its walls are of Cretaceous sandstone, capped on one side by a lava flow. All around the rim there is a wide low ridge of volcanic ejecta which has been laid down in water. The history of this remarkable feature is not clear.

Professor Frank C. Adams, of McGill University, presented the results of an investigation made by himself and Mr. E. J. Coker into the cubic compressibility of rocks and certain phases of rock flow. The apparatus employed was an improvement of that which had been used by Professor Adams in some remarkable experiments, the results of which were published five years ago. In the present experiments, nickel-steel tubes have been used and the compressibility of fourteen typical rocks determined, and the deformation of the rock-making minerals concerned were carefully studied by means of the microscope.

Mr. E. O. Hovey, of the American Museum of Natural History, presented three papers upon the Caribbean volcanic islands. He described the Soufrière of St. Lucia as being the result of waning volcanic activity manifested along ancient fissures, but not within any recognizable crater. The Boiling Lake of Dominica is considered to be within an ancient broken-down crater from the southern portion of which there was a superficial eruption of dust and fine lapilli in 1880. The third of these papers pertained to the present condition of Mont Pelé, which was stated to be in a condition of intermittent mild activity; the dome, which has formed as a feature of the eruptions which began in 1902, is still undergoing modifications, elevation and subsequent destruction by explosion being nearly balanced. The great spine was destroyed more than a year ago.

The six papers upon glacial geology which were read gave rise to much discussion. The first of the series was by Professor R. S. Tarr, upon the moraines of the Seneca and Cayuga Lake valleys. During the recession of the Wisconsin ice sheet a stand was made near the heads of the two lake valleys—Cayuga and Seneca. This major ice stand consisted of a series of minor halts in the receding ice which projected lobes up the two lake valleys, and minor lobes into the side valleys. By reason of the irregularity of topography and the several minor halts, a complex series of moraines was accumulated, both as lateral and terminal deposits, the latter being developed with especial intensity in the two major valleys south of the heads of the lakes.

The drumlins in the Grand Traverse region of the northwestern part of the southern peninsula of Michigan have been studied recently by Mr. Frank Leverett, of Ann Arbor, Mich., who contributed a paper on them which, in the absence of the author, was read by Professor Russell. Particular attention was devoted to modes of development, since more than one mode appears to have been operative; some drumlins have been sculptured from earlier deposits at the last ice advance, and some built up during that advance from material contained in the ice. Attention was called incidentally to heavy deposits of nearly pebbleless laminated clay, apparently laid down in interglacial lakes, for this clay has been molded to some extent into drumlin forms by a subsequent ice invasion. Large valleys excavated in this interglacial clay were briefly discussed and shown to antedate the production of the drumlins, the latter being in some cases built upon the valley bottom.

A second paper upon the drumlin areas of Michigan was delivered by Professor Russell. It described with some detail two regions in the northern peninsula of Michigan, in which drumlins form the most conspicuous features of the topography. One of these areas includes Les Cheneaux Islands and a part of the adjacent mainland, on the north shore of Lake Huron; and the other area is situated principally in Menominee County, to the west of Green Bay. The drumlins are for the most part smooth-surfaced, half-cigar-shaped hills of the normal type, but in a few instances instructive irregularities are present. Among these irregularities are: A flattening of a portion of the normally elliptical ground-plan, as if a marginal portion of a well-shaped drumlin had been removed by erosion, leaving an abnormally steep slope; deep transverse trenches at right angles to their longer axes; straight or curved trenches extending from their summits down their sides; irregular pits in their normally smooth surfaces; and, in one instance, a terrace-like shelf with a convex longitudinal profile, parallel with the crest-line of the drumlin on the side of which it occurs. In the valleys between the drumlins there are several eskers. From the evidence the conclusion is drawn that the drumlins of the Menominee area were produced by ice erosion from a previously deposited till sheet.

The drumlins of central New York State were the subject of a brief paper by Professor H. L. Fairchild, of the University of Rochester, who also summarized the more important glacial problems in the state. A third paper by Professor Fairchild took up the thesis that the theory of erosion by ice is a fallacy, in amplification of a paper presented by him at the preceding annual meeting of the society. The author gave arguments for arriving at the conclusion that deep ice-erosion of living rock has never been proven, and that it is practically impossible of accomplishment. In New York State there seems to be positive proof that there has been no effective excavation by ice in the valleys of the Finger Lakes, the field study thus sustaining the theoretical consideration of the question.

The stratigraphical section of the program showed the largest number of titles of papers offered and read. Professor W. G. Miller, of Toronto University, discussed the pre-Cambrian rocks in the vicinity of Lake Temiskaming, Ontario, not only from a stratigraphical, but also from an economic, point of view. The region in question shows at the base a complex assemblage of igneous rocks, including granite. Erosion of this complex has given rise to conglomerate and finer-grained slate-like rocks. Afterwards ensued a second period of erosion during which arkose and quartzite were deposited on the surface of the older two series. Finally each of these three series is intersected by dykes of pre-Paleozoic age. The second group or series, the conglomerate and slate, is of economic interest on account of the occurrence therein of fissure veins carrying important amounts of silver and of cobalt and nickel ores and smaller quantities of other ores.

In a paper on the paleogeography of St. Peter time, Dr. C. P. Berkey, of Columbia University, showed by means of charts and sections the probable varying distribution of land and water during the formation of the St. Peter sandstone of Minnesota. The rock was interpreted as of marine origin where early deposited. The region then became a land area with the production of sand-dune phenomena, after which there occurred another period of submergence. In the discussion which followed the reading of the paper the fact was brought out by Professor Gilbert van Ingen that rounded sand grains are not necessarily an indication of arid conditions of deposition, since they are found in coastal sand-dunes today. Dr. Berkey's second paper was upon the stratigraphy of the Uinta Mountains and announced the discovery of an erosion interval in the section, which favored the reference of the great basal Weber quartzite to Cambric age, rather than to Carbonic, as held by King, or to Devonic, as contended by Powell.

Professor A. W. Grabau, of Columbia University, in a paper on the relative areas of the Oneida and Shawangunk conglomerates advanced the theory that these beds represent different portions of a basal conglomerate in the transgressing Siluric sea. In another paper, Professor Grabau discussed Helderberg seas and the interrelationships of lower Devonic strata in the eastern United States. Charts were used in showing the long narrow Cumberland sea as this body of water is called. Mr. C. A. Hartnagel then, in some notes on the Ontaric (Siluric) section of eastern New York, traced the comparative sections to the west and to the east of the Helderberg Mountains and showed the continuous character of the Cobleskill beds. On the east the formation immediately beneath this is, probably, Salina in age, down to and through the Shawangunk conglomerate as the basal member of the Salina group.

The age of the Morrison formation of the Rocky Mountain region was the theme discussed by Mr. N. H. Darton, who has carried on extensive field work along the outcrops. It has been found that the Morrison formation is of wide extent in the Rocky Mountain region, from Montana to New Mexico, but evidence as to its age is meager. Abundant mammalian remains occur, but the paleontologists do not agree as to the horizon, some investigators regarding them as Jurassic and others as late Cretaceous. The meager fresh-water molluscan fauna is not definitive. Some time ago, Mr. Willis T. Lee found evidence that Morrison shales give place to Comanche deposits in western Oklahoma, and the author has found similar relations in the Two Butte uplift in southeastern Colorado, and concludes that the Morrison strata are of Comanche (Lower Cretaceous) and that sandstones occur representing both the Lakota and the Dakota sandstones of the Black Hills region.

In a paper on the classification of the Upper Cretaceous formations of New Jersey, Professor Stuart Weller, of Chicago University, reviewed the schemes proposed by the state survey at various times, and, by means of fossils, substantiated the subdivision which had been made by Knapp and Kümmel on lithologic grounds alone. Professor Weller then went on to discuss in detail in a second paper the fauna of the Cliffwood, N. J., clays, which form the most notable example of marine sedimentation in New Jersey during Raritan time.

The fossils of Cook's Inlet and the Alaska peninsula have been made the subject of careful study by Messrs. T. W. Stanton and G. C. Martin, of the United States Geological Survey. The section shows a great thickness of beds which are well provided with fossils. The beds seem to be closely related to the Jurassic strata of Russia. The scientific program was closed by Professor G. H. Perkins, of Vermont University, with a paper on the Tertiary lignite of Brandon, Vermont, and its fossil fruits. These historic beds were worked for fuel during the anthracite coal strike and as a result many specimens of fossil fruits were found, most of which are described now for the first time.

The following papers were read by title only: 'Occurrence of Gem Minerals in San Diego, Riverside and San Bernardino Counties, Cal.,' by George F. Kunz; 'Rocks from Mt. Desert Island, Maine,' by Persifor Frazer; 'Plumose Diabase and Palagonite from the Holyoke Trap Sheet,' by B. K. Emerson; 'Determination of Brucite as a Rock Constituent,' by Alexis A. Julien; 'Origin of Leached Phosphate,' by C. H. Hitchcock; 'Serpentine Deposits of Belvidere Mountain, Vermont,' by V. F. Marsters; 'The Shifting of the Continental Divide at Butte, Montana,' by Walter H. Weed; 'Nantucket Shorelines, III. Muskeget,' by F. P. Gulliver; 'The Dexter, Kansas, Nitrogen Gas Well,' by Erasmus Haworth; 'Relation of Lake Whittlesey to the Arkona Beaches,' by Frank B. Taylor; 'New Geological Formation in the Eo-Devonian of Annapolis County, Nova Scotia,' by H. M. Ami; 'Age of the Marine Limestones of West Bay, near Parrsborough, Cumberland County, Nova Scotia,' by H. M. Ami; 'Upper Trias of the Lander Basin, Wyoming,' by S. W. Williston; 'The "Red Beds" of Southwestern Colorado,' by Whitman Cross and Ernest Howe; 'Pleistocene History of Fishers Island, N. Y.,' by Myron L. Fuller; 'Pleistocene of the Chesapeake and Delaware Basins,' by A. Bibbins; 'The Loess of the Lower Mississippi,' by G. Frederick Wright; and 'The Loess and Associated Interglacial (Post-glacial) Deposits,' by B. Shimek.

The following candidates were elected to fellowship in the society: Nevin M. Fenneman, University of Wisconsin; Charles N. Gould, University of Oklahoma; Mark S. W. Jefferson, Michigan State Normal College; Benjamin L. Miller, Bryn Mawr College; Cleophas C. O'Harra, South Dakota School of Mines; Albert H. Purdue, University of Arkansas; Solon Shedd, Washington Agricultural College; Bohumil Shimek, Iowa State University; Gilbert Van Ingen, Princeton University; Ralph Arnold, U. S. Geological Survey; John A. Bownocker, Ohio State University; Reginald W. Brock, Canadian Geological Survey Department; Hiram D. McCaskey, Chief of the Mining Bureau of Manila; Henry Montgomery, Trinity University, Toronto; Arthur E. Seaman, Michigan College of Mines.

The officers of the society for the ensuing year are:

President—Raphael Pumpelly, of Dublin, N. H.

First Vice-President—Samuel Calvin, of Iowa City, Ia.

Second Vice-President—W. M. Davis, of Cambridge, Mass.

Secretary—H. L. Fairchild, of Rochester, N. Y.

Treasurer—I. C. White, of Morgantown, W. Va.

Editor—J. Stanley-Brown, of New York City.

Librarian—H. P. Cushing, of Cleveland, O.

Edmund Otis Hovey.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for November-December contains the following articles: 'The Embryological Development of the Skeleton of the Head of Blatta,' William A. Riley; 'The Arboreal Ancestry of the Mammalia,' W. D. Matthew; 'Localized Stages in Common Roadside Plants,' Joseph A. Cushman; 'An Arrangement of the Families and Higher Groups of Birds,' R. W. Shufeldt; 'Observations on Hearing and Smell in Spiders,' Annie H. Pritchett; 'Amitosis in the Embryo of Fasciolaria,' H. L. Osborn; 'The Transplanting of Trout in the Streams of the Sierra Nevada,' D. S. Jordan; 'A New Species of *Diaptomus* from Mexico,' A. S. Pearse; '*Hyla andersoni* and *Rana virgatipes* at Lakehurst, New Jersey,' W. T. Davis. There are also notes, reviews and lists of publications.

Annals of the Carnegie Museum, Vol. III., No. 1, contains the following papers: 'Minute (or Order) Book of the Virginia Court Held for Ohio County, Virginia, etc.,' edited by Boyd Crumrine; 'The Tropidoleptus Fauna at Canandaigua Lake, New York, with the Ontogeny of Twenty Species,' Percy E. Raymond; 'Two (new) Species of Turtles from the Judith River Beds of Montana,' O. P. Hay (*Baëna callosa* and *Aspideretes beecheri*), and 'A Preliminary List of the Hemiptera of Western Pennsylvania,' P. Modestus Wirtner.

The Zoological Society Bulletin, of New York, for January contains accounts of the newly erected ostrich house and small mammal house, a note on 'Wild Animal Photography,' a description of 'A Mosquito Object-Lesson at the Aquarium' and other interesting and valuable information regarding the work of this very active society.

The American Geologist for December contains as the leading article a paper by Charles S. Prosser assisted by Edgar R. Cumings, entitled 'The Waverly Formations of Central Ohio,' illustrated by three plates of half-tone views of the formations described. The region considered, which is near Columbus, had never been carefully described; but on investigation it affords the most satisfactory exposures of the Waverly formations to be found in central Ohio. Mr. N. Mistockles continues his serial on 'The Untenableness of the Nebular Theory' and Professor Hobbs has the concluding chapter on the 'Tectonic Geography of Eastern Asia.' G. P. Grimsley contributes a paper entitled 'A Theory of Origin for the Michigan Gypsum Deposits,' in which he supposes that they were deposited in an interior sea, and in explanation of the localization of the deposits compares it with the present Caspian Sea.

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 161st meeting of the society was held on Wednesday evening, January 11, 1905. The regular program comprised the following communications:

Undulations of Certain Layers of the Lockport Limestone: Mr. G. K. Gilbert.

Mr. Gilbert exhibited photographic views of two structures affecting beds near the top of the Lockport limestone. These had been previously described and figured by Hall, in his report on the geology of the fourth district of New York. One structure is a system of domes or arches occupying the whole surface of the rock and separated by narrow synclines. They are usually several feet in diameter, and are repeated downward through a series of strata. The other structure is a mammillation somewhat resembling ripple marks, and with a diameter of about one inch. The two structures occur in the same strata. The photographs were made in a new railroad cutting within the city of Niagara Falls, in a quarry three miles east of the city, and in water channels temporarily exposed at the Dufferin Islands, on the Canadian side. Mr. Gilbert was not satisfied with Hall's characterization of the structures as concretionary, but suggested no alternative. He thought them contemporary with the deposition of the strata, and not subsequent.

The Great Fault of the Bitterroot Mountains: Mr. W. Lindgren.

The Bitterroot Mountains in the western part of Montana rise for a distance of eighty miles like a long narrow block above the general level of a greatly dissected plateau or peneplain which extends over a large area in central Idaho and a part of the adjacent state of Montana. On the east the Bitterroot Mountains descend from an elevation of 9,000 feet to the level of the wide Bitterroot valley. From one end of the range to the other this slope is remarkably even and gentle, having an average declivity of twenty degrees. Its face consists of a zone of granite schist, perhaps averaging 1,000 feet thick, in which pressing and deformation of the crystals are intimately associated with numberless slipping planes with striation parallel to the slope of the front plane. The predominant rock of the range is a quartz monzonite with transitions into granite. These facts are interpreted as meaning that the frontal slope is formed by a great flat fault of normal character, along which both molecular and molar movement has occurred. The horizontal component would be at least 15,000 feet, the vertical at least 4,000. The depth below the surface at which this zone of schistosity was formed can scarcely have been more than 2,000 to 4,000 feet. The age of the uplifted peneplain is believed to be late Mesozoic and the fault is probably but little later. Slight faulting movements seem to continue along it up to the present time.

Artesian Water in Crystalline Rocks: Mr. Geo. Otis Smith.

The presence of artesian water in an area of crystalline rocks in the vicinity of York, Me., presents a hydrologic problem little discussed in geological literature. With closely folded and thoroughly indurated rocks the water circulation in the deeper rock zone must be along schistosity partings and joint openings rather than through pore openings in a gently inclined porous stratum. The impervious cover essential to the artesian type of supply of ground water is furnished by the greater degree of cementation of the natural openings in the rock near the surface. It thus follows that the pressure under which the water circulates in the rock becomes insufficient to overcome the internal friction near the surface, and upward escape is prevented. When a free vertical channel is provided by a well, the water rises in the well and in three cases cited overflows at the surface. The results of this hydrologic investigation will be presented in the forthcoming 'Contributions to Hydrology in the Eastern United States.'

Some Erratic Boulders in Middle Carboniferous Shale in Indian Territory: Mr. J. A. Taff.

Mr. Taff described the occurrence of erratic boulders of limestone, dolomite, chert and quartzite, of Silurian, Ordovician and probably Cambrian ages occurring in Middle Carboniferous shales several thousand feet above the base of the Carboniferous section in the Ouachita Mountains from the west end almost to the Arkansas line, a distance of nearly a hundred miles. The boulders range in size from an extreme length of sixty feet to small fragments and are promiscuously distributed in the shale. Some of them are angular while others are round as if water worn. No rocks in the Ouachita Mountains can be compared with the erratic boulders except probably some of the Ordovician cherts which occur 10,000 feet beneath the boulder bearing shale. The Arbuckle Mountains lie southwest of the Ouachita range in southwestern Indian Territory and trend nearly S. 60° W. almost at right angles to the bearing of the folds of the Ouachitas. The Arbuckle uplift extended southeastward beneath the Cretaceous will pass twelve to fifteen miles south of the west end of the Ouachita Mountains. The identity, lithological and paleontological, of a large part of the Ordovician and Silurian strata, in the Arbuckle uplift, with the erratic boulders in the Carboniferous shale of the Ouachita Mountains, and the local relations of the uplifts press toward the conclusion that the erratics had their sources in a range or group of mountains in the region now occupied by southern Indian Territory and northern Texas. The size of the boulders and their disposition in the marine shales show that without any reasonable doubt they were floated by the medium of ice from a mountainous land into a Carboniferous sea now occupied in part at least, by the Ouachita Mountains. The hypothesis of ice transportation is supported by the occurrence of certain scored or striated chert and limestone boulders found with other erratics in the shale. The cause of the scorings found in the chert boulders is a problem now receiving further study. A fuller discussion concerning the occurrence and characteristics of these erratic boulders will be published at an early date in some geological journal.

Geo. Otis Smith,
Secretary.

THE BOTANICAL SOCIETY OF WASHINGTON.

The twenty-third regular meeting of the Botanical Society of Washington was held Saturday evening, October 16, 1904. The following papers were presented:

Vitality of Buried Seeds: Dr. J. W. T. Duvel.

A review was given of the results of the germination tests of 112 different samples of seed which had been buried in a heavy clay soil for one year. The seeds were buried at the three different depths of 6–8, 18–22 and 36–42 inches.

The majority of the seeds retained their vitality better the deeper they were buried.

With but few exceptions, the seeds of cultivated plants had either decayed or germinated and afterward decayed, at all depths.

Weed seeds, in some cases, retained their vitality remarkably well. The results indicate that the preservation of the vitality of weed seeds when buried in the soil is directly proportional to the noxiousness of the plants producing them.

Drug Plant Investigations in the Department of Agriculture: Dr. Rodney H. True.

The present organization of this line of investigations includes two different lines of work. Field investigations are now being carried on in Vermont, at Washington, D. C., in South Carolina and in Texas, where areas of land of from four to twenty acres are reserved for use in this connection.

In South Carolina experiments on a commercial scale are in progress, several thousand pounds of drugs having been marketed last fall.

The laboratory investigations are carried on chiefly at Washington in three laboratories: the laboratory of histology, where questions of structural and plant physiological nature are under investigation; the laboratory of pharmacognosy, where the study of improved processes of handling the products is given especial attention; and in cooperation with poisonous plant investigations, laboratory of pharmacology, where the physiological action of drug plants and products is tested. In addition to these laboratories, for all routine chemical work, cooperation with the bureau of chemistry is afforded.

Among the problems under investigation are, first, the domestication and cultivation of valuable native drug plants now being depleted, such as hydrastis and cascara sagrada; second, the cultivation of drug plants furnishing products now exclusively or chiefly produced abroad and imported, as, for example, belladonna, licorice, capsicum, opium poppy and many others; third, a careful scientific study of processes involved in curing and fermentation or in otherwise treating the fresh material in order to bring it in best condition to the market.

Do Segregations of Character Pairs Occur at Other Points in the Development of Organisms than the Maturation of Germ Cells: Professor W. J. Spillman.

The speaker pointed out that the distribution of color on spotted animals could be explained on the assumption that the color potentialities separate in cell divisions concerned only in the somatic development of the animal, and that bud variation might possibly be due to the same thing. If such separations do occur, very distinct cases of mutation might arise in consequence thereof. In this connection it is interesting to note the conclusions of biologists who have investigated the subject of embryology. They conclude that in some embryos the cells resulting from the first one or two divisions in the embryo have almost identically the same inheritance, and that a single one of these cells is capable of developing into a complete embryo, usually, however, dwarfed in character. In other embryos, if one of the two cells resulting from the first division is destroyed, the other cell develops into a portion of the embryo, presumably that portion that would have developed from that cell if the other cell had lived, indicating that in the first division a separation of characters was made that gave the two cells a different inheritance.

H. J. Webber,
Corresponding Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

The 155th regular and twenty-first annual meeting of the society was held Thursday evening, January 12, in the assembly hall of the Cosmos Club. The business of the evening consisted in the presentation of the annual reports of the secretary and treasurer and of the election of officers for the ensuing year. The election resulted as follows:

President—S. S. Voorhees.
First Vice-President—L. M. Tolman.
Second Vice-President—Allan Wade Dow.
Secretary—Atherton Seidell.
Treasurer—Fred. P. Dewey.
Four additional members of the Executive Committee—Messrs. E. T. Allen, Frank K. Cameron, Edwin A. Hill and L. S. Munson.

Professor F. W. Clarke was nominated on behalf of the Chemical Society as vice-president of the Washington Academy of Sciences.

At the conclusion of the election of officers, Dr. W. A. Noyes, of the National Bureau of Standards, delivered an address upon 'The Work of the Bureau of Standards.'

A. Seidell,
Secretary.

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

The fifty-sixth regular meeting of the section was held Friday evening, December 16, in the Lowell building, Massachusetts Institute of Technology, with President Norris in the chair. About 150 members and guests were present.

Professor Edwin J. Bartlett, of Dartmouth College, gave an address entitled 'An Evening with the Alchemists,' in which he described the processes and apparatus used by the alchemists, and showed a large number of lantern slides of contemporaneous pictures of alchemical utensils and interiors of the laboratories of the middle ages.

Arthur M. Comey,
Secretary.

THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

The thirty-fifth annual meeting of the academy was held at Milwaukee, December 28 and 29. The program contained twenty-six titles as follows:

James Davie Butler: 'Charles Kendall Adams—His Place in Three Universities.'

C. S. Slichter: 'The Specific Capacity of Wells.' (By title.)

J. H. Farley: 'The Concept of Motion.'

J. S. Roeseler: 'The Present Status of the Wisconsin Industrial School for Boys—Its Mechanism and Methods.'

E. B. Skinner: 'The Determination of the Value of the Right of Way for Wisconsin Railroads.'

E. B. Hutchins, Jr.: 'A Contribution to the Chemistry of the Tellurates.'

F. L. Shinn: 'On the Electrical Conductivity of Vapors.' (By title.)

Louis Kahlenberg and Herman Schlundt: 'On the Evolution of Hydrogen During the Action of Sodium on Mercury.'

Louis Kahlenberg: 'On the Measurement of Osmotic Pressures.'

Edward Kremers: 'On Classification of Carbon Compounds, II.'

Wm. H. Hobbs: 'Some Examples of Fault Networks.'

Dr. Sigmund Graenicher: 'The Relations of the Andrenine Bees to the Entomophilous Flora of Milwaukee County.'

R. H. Denniston: 'The *Russulas* of Madison and Vicinity.'

George M. Reed: 'Infection Experiments with *Erysiphe Graminis*.'

Valentine Fernekes and C. E. Brown: 'The Fungi of Milwaukee County and Vicinity.' (By title.)

R. A. Harper: 'Spore Formation in *Cordyceps Herculea* Schw.'

S. P. Nichols: 'The Nature and Origin of the Binucleated Cells in Certain *Basidiomycetes*.'

A. H. Christman: 'Observation on the Wintering of the Grain Rusts in Wisconsin.'

W. D. Frost and E. V. McComb: 'Soil Bacteria in the Vicinity of Madison.'

W. D. Frost, C. G. Davies and H. F. Helmholtz: 'The Viability of *Bacterium Diphtheriæ*.'

George W. and Elizabeth G. Peckham: 'The *Attidæ* of Borneo.' (By title.)

W. S. Marshall: 'Experiments with Caddis-fly Larvæ.'

George Wagner: 'Notes on the Behavior of *Physa Ancillaria*.'

M. V. O'Shea: 'The Psychology of Linguistic Development in the Individual.'

C. E. Brown: 'The Fluted Stone Axes of Wisconsin.'

A. G. Laird: 'The Greek and Persian Armies at Thermopylæ.' (By title.)

The attendance was not large, but the sessions were marked by strong interest on the part of all present, and the papers were, as a rule, freely discussed.

The meeting was noteworthy on account of the inception of plans for strengthening the work of the academy. Steps were taken looking toward the publication of the *Transactions* in series instead of in a single volume of two parts as heretofore. A committee was appointed to see what may be done in the way of increasing the exchange list and filling gaps in the library. Five hundred dollars were appropriated for the work of this committee. The academy has already a valuable library, consisting almost entirely of transactions of learned societies from all parts of the world.

Part 2 of Vol. XIV. of the *Transactions* was issued in September, 1904.

E. B. Skinner,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The fourth meeting of the club for the year 1904–05, was held on January 24. The following papers made up the program of the evening:

The Panama Canal—a symposium:

F. E. Turneaure: 'Engineering Features.'

W. A. Scott: 'The Economic Aspects.'

W. D. Frost: 'The Hygienic Problems.'

F. W. Woll,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

The 157th meeting of the Elisha Mitchell Scientific Society of the University of North Carolina was held in the chemical lecture room, Tuesday, January 10, 7:30 p.m., the following program being rendered:

Professor William Cain: 'The Theory of Metal or Reinforced Concrete Domes.'

Professor J. H. Pratt: 'Steel Hardening Metals.'

Alvin S. Wheeler,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

THE BITING POSITION OF ANOPHELES.

It is a curious fact, as shown by Dr. J. B. Smith's communication in Science for January 13, 1905, that no observer, from the number cited, has noted the exact position of this mosquito when biting. The writer, in his communication in the December 2, 1904, issue, based his statement upon observations made in 1903 in the northern woods of Minnesota, where a number of individuals of *A. maculipennis* were allowed to fill themselves with blood from the hand, in an endeavor to see how long a time was required by them to digest a full meal (page 170 Eighth Annual Report of the State Entomologist of Minnesota). As I recall the experiment, my impression is that these mosquitoes, when biting, took a position somewhat resembling their resting position, with body and beak more nearly in line, and not at right angles as seen in *Culex.* I shall have to include myself in the army of non-observants to the extent of saying that I am not absolutely sure of this. This was made clear in my communication on page 170 of the issue of Science referred to, where I said, 'While we may be mistaken, we are under the impression that this genus, in biting, etc.' As Dr. Smith very rightly says in his letter 'I do not understand him (Washburn) to say positively that the figure is inaccurate, only that it had been his belief that the biting position resembled the resting position more nearly.'

As I remember the chart at St. Louis taken from an illustration of Nuttall & Shipley, the biting *Anopheles* is shown with body horizontal. This may be correct, but I note that Dr. Herbert Johnson, who worked on *Anopheles* for Dr. Smith, and who is quoted in the latter's communication, says with reference to the position of the body of *Anopheles* when biting, 'It is always somewhat oblique.' It was, I believe, this horizontal position with beak at right angles, which caught my eye in looking at Dr. Smith's most complete and excellent exhibit.

At the same time it will possibly occur to many that there may be individual variations in the position of biting mosquitoes, due to different configurations, greater or smaller, of the surface at the immediate point where the insect is working. The time is not far distant when this feature in the activities of *Anopheles* can be put beyond question. In the meantime it is to be hoped that some more observant workers, following Dr. Smith's suggestion, will let us hear from them on this point.

F. L. Washburn.

Minnesota State Experiment Station,
January 19, 1905.

UNIVERSITY REGISTRATION STATISTICS.

To the Editor of Science: The registrar of the University of Wisconsin has called my attention to a discrepancy that occurs in the figures furnished by him for the article on 'University Registration Statistics,' published in Science, December 30, 1904. In former years the short course and dairy students, who do not enter the university until December 1, were reported, whereas they were not included in the 1904 table. Four hundred and thirty-nine short course and dairy students were enrolled on December 1, 1904, and inasmuch as none attended the summer session of 1904, 439 should have been added to the total, giving a grand total for the University of Wisconsin of 3,370 instead of 2,931, and consequently showing a normal increase instead of the decrease represented by the figures in the table. These additional students were reported a fortnight after the appearance of the article, but it seems only fair to call attention to the omission.

Rudolf Tombo, Jr.

SPECIAL ARTICLES.

GENERIC NAMES OF SOFT-SHELLED TURTLES.

In a recent paper 'On the Existing Genera of the Trionychidæ' (*Proc. Amer. Philos.*

Soc., XLII., pp. 268–274) Dr. O. P. Hay, among other questions, endeavors to show that Wagler's *Aspidonectes* must stand for the large genus of soft-shelled turtles typified by the species *Testudo triunguis,* and that *Amyda* must be regarded as a synonym of the former. As I shall show below, the case must be reversed so that *Aspidonectes* becomes a synonym of *Amyda.*

Dr. Hay proceeds from the assumption that Wagler (1830) was the first author to subdivide the genus *Trionyx,* and if that were the case his reasoning would undoubtedly hold good. Unfortunately the subdivision was undertaken as early as 1816 by Oken. In his 'Lehrbuch der Zoologie,' volume II., p. 348, the latter divided the genus in two, one containing the majority of the species, which he called *Amyda,* and one for the single species *T. granosus,* which he expressly calls *Trionyx granosus,* thus evidently reserving the generic term *Trionyx* in a restricted sense for this species. He thus anticipated Wagler by fourteen years in limiting *Trionyx* to the genus which afterwards has been currently known as *Emyda.* The part of Dr. Hay's argument which relates to the latter is, therefore, not affected by Oken's action. But *Amyda* and *Aspidonectes* are not exactly coextensive, inasmuch as Oken does not definitely place *T. subplanus* in either of the two genera, being uncertain as to its affinities and referring to it both as *Amyda subplana* and as *Trionyx subplanus.* Consequently it can not with any show of reason be made the type of any of these genera.

The next man to adopt Oken's name *Amyda* was Fitzinger, who in 1835* restricted it to three species, viz., *T. subplanus, T. muticus* and *T. euphraticus.* As shown above, *T. subplanus* can not be Oken's type, neither can *T. muticus,* which was described long after Oken. There remains consequently for type *T. euphraticus.*

It thus becomes unnecessary to discuss Bonaparte's subsequent employment of *Amyda* in 1836, but it may not be out of the way to observe that his arrangement can not be made to differ from Fitzinger's of the previous year, inasmuch as it is a paraphrase pure and simple of this author using his characters verbatim and quoting all the subgeneric names as '*Aspidonectes,* Fitz.,' '*Platypeltis,* Fitz.,' '*Pelodiscus,* Fitz.,' and '*Amyda,* Fitz.,' the only difference being that Bonaparte does not mention more than one of the species Fitzinger included.

As Dr. Hay has clearly shown, the type of Wagler's *Aspidonectes* by elimination is *A. triunguis.* He does not mention in his article in which genus he would place *T. euphraticus,* but I think there can be but little doubt that the two species are strictly congeneric, and that consequently *Aspidonectes* becomes a synonym of *Amyda.*

If *T. subplanus* is generically distinct it must retain the name *Dogania* given it by Gray in 1844. Dr. Hay considers it congeneric with *Aspidonectes* (now *Amyda*), but I wish to call attention to the fact that it is not only unique in having all the pleuralia separated by the neuralia, but also in lacking the median process of the hypoplastron, as shown recently by Dr. Siebenrock. Altogether it possesses so many peculiar characters that it seems more worthy of separation than the North American species which Dr. Hay would recognize as *Platypeltis.*

LEONHARD STEJNEGER.

U. S. NATIONAL MUSEUM,
January 19, 1905.

* There is no reason for quoting his paper in the first volume of *Annalen des Wiener Museums* from 1836. It was certainly published before Bonaparte's 'Tabula analytica,' as he quotes Fitzinger throughout.

A NEW FIELD FOR LANGUAGE STUDY.

THE latest form of instrument in which a spoken language is magnetically recorded in a steel piano wire, was shown to the members of Section B at the recent meeting of the American Association for the Advancement of Science at Philadelphia. The wire is carried on two spools driven electrically, and can be reeled from either to the other. During this operation the wire passes between the poles of a small magnet, and by magneto-induction the spoken words are reproduced in the receiving instrument. If the motion of the wire is direct you hear the words as they are ordinarily heard in conversation. If the wire is reversed, you hear the same sounds presented in reverse order. You hear what you would hear if you were to follow the sound waves after they have passed the ear, traveling through them in a radial direction with twice the velocity of sound. The reversed words are perfectly definite in character, and constitute a new language related in a simple mathematical way to that originally spoken. One might learn to pronounce a sentence of this language, thus derived from an English sentence, impress it upon a fresh wire, and the instrument on reversal would translate it into English. This new language might be called the Hsilgne. It is related to the English language in a way that may be roughly represented by the equation

$$\text{Hsilgne} = \text{English} \times \cos 180°.$$

This word forming the first member of the equation is not the English spelling of the word English when pronounced backwards. In order to properly typify the relation between the two languages, not only should the order of the letters be reversed, but each letter should be reversed as to right and left, as when the word is seen by reflection from a mirror.

The ear may, however, be supposed to traverse the system of sound waves produced by an orator, in any one of an infinite variety of directions. The path traversed by the ear, and a radial line drawn to the mouth of the speaker, may make any angle a between 0° and 180°. If the velocity of the ear be correspondingly varied, we shall have in the above case a great spectrum of languages lying between Hsilgne and English. The variable language will in general be represented by the equation

$$\text{Language X} = \text{English} \times \cos a.$$

As the angle a approaches 90°, the variable language becomes more barbarous and inarticulate. When $a = 90°$, the ear would be moving parallel to the wave fronts, and nothing would be heard. The conditions realized are analogous to those which hold in a photographic plate when the fog line is approached, separating the negative from the positive picture. It would be very interesting to determine whether there is any radical difference between the positives and the corresponding negatives of a spoken language. Each language, corresponding to a given value of a with English as a base, would have a corresponding negative, where the angle is $a + 180$. The Poulsen instrument is now perfectly adapted to the study of the relation of any language to its negative, if either be placed on record in the wire. Of course in such a reversal as the Poulsen instrument gives, the grammatical construction is also reversed. Some of the difficulties that would be met in learning to talk Hsilgne can be realized by reading this communication backwards, beginning with the last word and ending with the first. In such a reading the words themselves are not reversed, but the order in which they are presented to the ear is that which would hold in the negative language.

Francis E. Nipher.

QUOTATIONS.

SALARIES AT HARVARD UNIVERSITY.

Speaking roughly, the rule may be said to be that a full professor in Harvard College receives $4,000 a year, an associate professor $3,000, an assistant professor $2,000, an instructor $1,000, and an assistant from $250 to $400. In the last academic year there were in the college 51 full professors, 2 associate professors, 38 assistant professors, 7 lecturers, 1 tutor, 88 instructors, and 87 assistants. Of the professors, 14 received $5,000; 1, $3,600; 10, $3,500; 3, $3,000; 4, $2,000; and 1, $1,000. This showed a total item of salaries of about $227,000. The actual average, based on the exact figures, which are not those given here, was $3,984, which confirms the impression that the Harvard professor is a $4,000 man.

The incomes of the other classes of instructors show similar variations. The two associate professors receive $3,500; but salaries of the assistant professors range from $3,000 down to $500; the average being $2,160. The lecturers average $781 each, while the compensation of instructors ranges from $2,000 to $100, with an average of $999. The assistants receive anywhere from $1,200 down to $20, the average last year being $328; thus it is seen that a large part of the teaching force of Harvard College is composed of men who receive salaries that would not tempt men to become conductors and motormen on a street railway, and Harvard (*miserabile dictu*) is probably better off than any other American college.

These salaries from the point of view of prosperous Harvard graduates are positively startling, especially if one considers the kind of people with whom a teacher necessarily rubs elbows, if he holds a position in the service of a college. Of course, men don't teach at Harvard or at any other American college of high standing for the mere sake of money. Anybody who is competent to be a full professor at Harvard is capable of securing several times the income of his professorship in some other line of work. The list of teachers contains the names of countless men of world-wide reputation, who by merely signifying that they would accept better positions could step at once into places with a pecuniary return of three, four or even five times what they now obtain.

As has been said, it is probably true that in Colonial days the Harvard teacher was virtually on a financial level with the successful lawyer and the prosperous butcher or baker, as to-day he certainly is not. Until recently, too, the level of salaries in Harvard college rose somewhat rapidly from generation to generation, though never keeping pace with the advances in the emolument of the other professions and trades which college graduates enter.—The New York *Evening Post*.

CURRENT NOTES ON METEOROLOGY.

KITE METEOROLOGY OVER LAKE CONSTANCE.

IN a recent note under the above heading, reference was made to the observations carried on by Dr. Hergesell 'during the years 1900, 1902 and 1903' on the Lake of Constance. The compiler of these 'Notes' desires to correct that statement, for the reason that no observations were made in 1900. The following quotation from Dr. Hergesell's report to the International Meteorological Committee in 1903 makes the situation clear: "In July, 1900, I had the idea of using the speed of a boat to correct the wind conditions, and I made some experiments with a motor boat (on the Lake of Constance), but without raising an instrument. In the month of August, 1901, Mr. Rotch, in America, was the first to lift an instrument in nearly calm weather by using a steamboat which he could manœuver at will. The proposal of Mr. Rotch * * * led me to recommence my experiments on the Lake of Constance (in June, 1902)."

WIND CHARTS OF THE SOUTH ATLANTIC.

THE Hydrographic Department of the British Admiralty has recently published a volume of monthly wind charts of the South Atlantic Ocean, prepared by the marine branch of the Meteorological Office. The region embraced by these charts extends from the equator to latitude 65° south. Nearly a million sets of observations were used in the compilation. The results are shown by means of wind roses in 5° squares. Isobars and isotherms are also drawn, and numerous notes concerning the climatic features along the coast of Africa and of South America are included. It may here be noted that fogs seldom occur north of latitude 30° except near land, and that the southwestern part of the ocean is the only region in which ice is ordinarily found.

SUNSPOTS AND RAINFALL.

MR. H. I. JENSEN, of Sydney, New South Wales, discusses the relations between solar and terrestrial phenomena in the *Proceedings of the Royal Society of New South Wales,* Vol. 38. In general the author agrees with the results obtained by Sir Norman and Dr. W. J. S. Lockyer regarding the connection existing between solar and meteorological variations, but he inclines to the opinion that the epochs of sun-spot maxima are generally the periods of excessive rainfall. One point—an important one—upon which Mr. Jensen insists is the need of laying more emphasis upon geographical position when the meteorological conditions of any place are considered.

NOTES.

Mons. J. Vallot has recently sent to his correspondents a reprint from the *Revue Illustrée* for July 1, 1904, containing a fully illustrated account of his scientific work on Mont Blanc, with views of his meteorological observatories, and a bibliography of his publications.

A relation between sunspots and thunderstorm frequency at Vienna is set forth by G. Walter, in *Das Wetter* for December, 1904. The author believes that a year with few thunderstorms almost always precedes a year of sun-spot maximum. These results do not agree with those obtained some years ago by von Bezold; in fact, there is a very considerable diversity of opinion in regard to almost all the relations between solar and meteorological phenomena.

R. DeC. Ward.

EUGENE G. BLACKFORD.

Eugene G. Blackford, who died recently, was known to American zoologists for his many-sided and practical contributions to the study of fish and shell-fish. He was for a long time associated with the United States Commission of Fisheries, and was a supporter of Professor Baird in his efforts to create the national commission: he was Commissioner of Fish and Fisheries of the State of New York from 1879 to 1892, and it was under his administration that many measures were taken with regard to the stocking of waters and the protection of fish. The survey and renting of the state oyster-grounds, it may be mentioned, was due to his initiative. He devoted himself particularly to applying scientific results to practical purposes, and his efforts in promoting fish-hatching, in introducing new and serviceable species of fish, in stocking waters, and in devising new methods for catching, preserving, shipping, and storing fish, had a permanent effect upon the markets of the country; he frequently brought to the consumer fish which were new to him, sometimes even new to science, such, for example, was the red snapper, *Lutjanus blackfordi*. In 1881 he was instrumental in founding the state fish hatchery at Cold Spring Harbor; in 1890 he established there, under the auspices of the Brooklyn Institute of Arts and Sciences, a biological station, which developed successfully and has recently been adopted by the Carnegie Institution. As early as 1877* he mooted the establishment of a New York aquarium and he later designated the Battery building as a suitable nidus for its growth. He was the first, as far as I am aware, to make this practical suggestion, and to his efforts and influence no small part of the success is due in creating the present institution. He was most influential in supporting the establishment of the museum of the Brooklyn Institute of Arts and Sciences, and in the latest time he took a prominent part in creating in Brooklyn a teaching museum for children.

The following are the more important of Mr. Blackford's publications:

1876. 'On the Need to Obtain Statistical Studies of Fish Catches in the United States.' *Report of American Fish Culturists' Association*, V. meeting, p. 5.

1877. 'Reference to the Length of Time Milt of Salmon Could be Kept Successfully.' *Ibid.*, VI. meeting, p. 99.

1877. 'Introduction of Pompano into the Northern Markets.' *Ibid.*, p. 124.

1878. 'Peculiar Features of the Fish Market.' *Ibid.*, VII. meeting, p. 77.

1879. 'Whitebait in American Waters.' *Ibid.*, VIII. meeting, p. 11.

1882. 'Report on the Merits of the Rainbow Trout.' *Ibid.*, XI. meeting, p. 23.

1883. 'On the Size of Marketable Lobsters.' *Ibid.*, XII. meeting, p. 414.

1883. 'A Few Facts in Relation to the Food and Spawning Season of Fishes on the Atlantic Coast.' *Ibid.*, XIII. meeting, p. 5.

1883. 'Regarding the Pollution of the Water of New York Bay.' *Ibid.*, p. 73.

1884. 'Is Legislation Necessary for the Propagation of the Ocean Fisheries.' *Ibid.*, XIII. meeting, p. 60.

* He referred to the 'necessity of an aquarium in New York City'; and he expressed the hope 'that a public enterprise might be started which would be a free public institution.' 'Report of the Am. Fish Culturists' Association,' 1877, p. 107.

1885. 'The Oyster Beds of New York.' *Ibid.*, XIV. meeting, p. 85.

1885. 'Report of the Commissioner of Fisheries of the State of New York in Charge of Oyster Industry,' pp. 70.

1886. *Ibid.*, II. report, pp. 23.

1886. 'Report of the Commissioner of Fisheries of the State of New York.' XIV. report, p. 7.

1887. *Ibid.*, 'Oyster Industry.' III. report, pp. 27.

1887. *Ibid.*, XV. report, pp. 17.

1888. *Ibid.*, XVI. report, pp. 30.

1899. 'On the Spawning Season of the Eel.' Science, N. S., Vol. IX., p. 741.

Bashford Dean.

Columbia University,
January 25, 1905.

ILLINOIS RIVER PLANKTON.

The Illinois State Laboratory of Natural History has published, as Article II. of the sixth volume of its Bulletin, a report on the results of a virtually continuous study of the minute plant and animal life, or plankton, of the Illinois River and its tributary waters, carried on for five successive years by the staff of the Illinois Biological Station. This makes a volume of 534 pages, illustrated by 2 maps, 11 half-tone plates, and 37 full-page diagrams.

Opening with an elaborate description of the Illinois River and its drainage basin, this report treats of the effect of variations of temperature and peculiarities of chemical condition on the life of the stream, and presents at length and in detail a comparative study of 630 plankton collections made from the river at Havana, from one of its tributaries which empties into it at that point, and from five bottom-land lakes of various character and variously related to the main stream. These collections were so made, at regular intervals, with identical apparatus, and by a uniform method, that they can be compared with each other quantitatively, and may be used as the basis of general conclusions concerning the system of minute life in these waters, from season to season and from year to year.

It appears from these studies that the plankton is distributed in the main stream of the Illinois River about as evenly as it is in the stationary waters of a lake, and that generalizations based on an examination of a small part of it are consequently as reliable as those concerning that of a lake. The ratio of the plankton of the river, year in and year out, was 2.7 parts per million of the water in the stream, and its total average amount moving down stream past any given point reached the astounding aggregate of 75,000 tons per annum, or 8.5 tons an hour. This is about 15 times the total weight of the fish taken from the river in a year.

The production of the plankton falls to its minimum, as a rule, in January and February, and reaches its maximum in April, May, and June. Floods, of course, dilute it, and falling waters concentrate it, but, on the other hand, a season of general high water increases its total quantity, and a season of general low water decreases it. Light and heat favor its development, and it is consequently more abundant, other things being equal, in a season during which clear and warm weather preponderates than in a cold and cloudy one. The freezing of the river does not seriously affect it, unless the ice-sheet continues until the water becomes foul with the gases of decay. The addition of sewage to the river water greatly increases the production of this minute life by increasing the supply of available food, although an excessive amount of sewage may render the water too foul for it at the point of discharge.

The production of plankton is less in short streams with relatively swift current than in long streams with slow current, and short tributaries consequently tend to dilute the plankton of the main stream. On the other hand, the stagnant and relatively permanent waters of shallow lakes bear a more abundant plankton than the temporary waters of flowing streams, and the outflow from such lakes hence enriches the plankton of the river. Parts of a stream with many small tributaries will contain less plankton than those with which numerous lakes are connected.

The bottom-land lakes differ widely in the amount of plankton which they contain, this being least in those with an abundance of coarse submerged water plants, and greatest in those virtually free from such vegetation. The reasons for this difference seem not well established in this paper, but they are possibly connected with differences of light and heat already referred to. The most productive body of water examined was a large permanent pond, with neither inlet nor outlet at a low stage of water, and with bottom and shores of bare mud.

The conditions which favor a large annual production of this minute aquatic life also seem to favor a large catch of fish, but no direct connection of cause and effect is here made out. The plankton is, however, an indispensable element in the food of fishes, the young of nearly every species in our waters being absolutely dependent upon it at some period of their lives, and adult fishes of several species making large use of it during the season of its greatest abundance.

No study of the minute life of a river system has heretofore been made of equal extent, thoroughness, and scientific character with that reported in this paper, and a knowledge of the facts contained in it is indispensable to an understanding of some of the problems of a scientific fish-culture in fresh-water situations.

The work here reported is a part of that of the biological survey of Illinois. It was planned, established, and equipped by Dr. S. A. Forbes, director of the State Laboratory, and was done under the immediate superintendence of Professor Frank Smith, of the University of Illinois, during the first fifteen months, beginning with April, 1894, and of Dr. C. A. Kofoid, superintendent of the station, the writer of this report, during the remainder of the five-year period.

THE MISSOURI BOTANICAL GARDEN REPORT.

Advance galleys of the administration report of this well-known institution, for which we are indebted to its director, show the customary progress. In 1904 the number of species and varieties of plants cultivated was increased from 11,357 to 14,207, an addition of 25 per cent. The herbarium was enlarged from 465,205 to 489,310 specimens, an increase of a little over 5 per cent., and the total of books and pamphlets in the library was raised from 42,262 to 45,892, or something over 8 per cent.

The world's fair recently held in St. Louis raised the visitors to the garden to over three times the customary number, a total of 316,747, or about 2 per cent. of the entire paid admissions to the exposition. That these visitors were of an unusually intelligent and interested class is noted from observation and inferred from their purchase of a little handbook of the garden, the sales of which amounted to 1.51 per cent. of the number of visitors in contrast with an earlier average of .246 of 1 per cent.

The report also contains information as to the school of botany, the gardening course, the research work at the garden and the testamentary flower sermon, banquets, and flower show, all of which latter were influenced by the holding of the St. Louis exposition, at which the garden met with recognition in the form of two grand prizes and several minor awards.

The financial report of the trustees shows that street improvements, sewers, property expenses and the like have wiped out their savings of the past fifteen years, on which needed buildings and enlargements have been planned by the director, and it is evident that unless unexpected aid is rendered the garden by some public-spirited citizen these improvements must necessarily be deferred for at least ten years, although the maintenance of the establishment on its present scale is not in doubt, and there is assurance in its unencumbered endowment of some $3,000,000 that gradually it will enlarge to an importance and usefulness equaling the most sanguine expectations of its friends.

THE NATIONAL GEOGRAPHIC SOCIETY.

Professor Willis L. Moore, chief of the U. S. Weather Bureau, was elected president of the National Geographic Society, at the last meeting of the board of managers, at Washington. Professor Moore has been actively identified with the society for many years and has served on the board of managers since 1897. At the same meeting Mr. Henry Gannett, chief geographer of the U. S. Geological Survey was elected vice-president of the society. Mr. Gannett was one of the incorporators of the society in 1888, and has served continuously on the board since that date. At the same meeting Hon. O. P. Austin, chief of the Bureau of Statistics, was elected secretary, Mr. John Joy Edson, president of the Washington Loan and Trust Co., was elected treasurer; Gilbert H. Grosvenor, editor; and Miss Eliza R. Scidmore, foreign secretary.

The society is now entering upon its eighteenth year. It has a total membership of 3,400, of whom 1,125 are residents of Washington, and 2,275 distributed throughout every state in the union and in nearly every country in the world. Its object is the increase and diffusion of geographic knowledge which it accomplishes:

1. Encouraging worthy plans for exploration. The society has sent one expedition to Alaska, another to Mont Pelée, Martinique, and La Souffrière, St. Vincent, and has been associated with several Arctic and other expeditions. At present its representative has direction of the scientific work of the Ziegler Polar Expedition, and is second in command.

2. By publishing an illustrated monthly magazine, the *National Geographic Magazine* and many large maps.

3. By an annual series of thirty addresses delivered in Washington by prominent men. The speakers this year have included Hon. John W. Foster, Wm. E. Curtis, Baron Kentaro Kaneko. Charles Emory Smith, F. H. Newell, Gifford Pinchot, G. K. Gilbert, etc.

4. By the maintenance of a library.

The society has now been established in its handsome new home, Hubbard Memorial Hall, for nearly a year. It was erected as a memorial to the first president of the society by the family of Mr. Hubbard.

SCIENTIFIC NOTES AND NEWS.

After twenty years of service as United States commissioner of labor, Dr. Carroll D. Wright retired from that office on January 31, and went to Worcester, Mass., to assume the presidency of Clark College. His successor, Dr. Charles P. Neill, took charge of the Bureau of Labor on February 1.

Fish Commissioner George M. Bowers has been notified of President Roosevelt's desire that he remain at the head of the Bureau of Fisheries during the next administration. The president has several times expressed his approval of the manner in which the affairs of the bureau were being conducted, and it is reported that he recently reiterated his satisfaction, remarking that all he asked for the next four years was a continuance of the energetic and zealous work which has characterized Commissioner Bowers's seven years of service.

Professor A. Auwers, the eminent astronomer of Berlin, has been elected an honorary member of the St. Petersburg Academy of Sciences.

The cross of officer of the Legion of Honor has been conferred by the French government on Dr. Otto Nordenskjöld for his South Polar explorations.

The Société Nationale d'Agriculture de France has awarded to Professor Wm. B. Alwood, of Charlottesville, Va., a diploma and silver medal for his recent work in pomology, especially as relates to the fermentation of by-products from apples. A gold medal was also awarded the exhibit on Œnological Technology prepared by Professor Alwood for the St. Louis Exposition.

Mr. N. H. Darton, of the U. S. Geological Survey, has been awarded a gold medal for his geological model of the Black Hills, exhibited by the South Dakota Commission at their section in the Mines and Mining building, at the St. Louis Exposition.

Dr. G. B. Halsted's 'Rational Geometry,' reviewed in Science last week, is being translated into French by Professor C. Barbarin, president of the Société des sciences physiques et naturelles de Bordeaux. His address on the 'Message of the Non-Euclidean Geometry,' given as vice-president of the American

Association last year, will be translated into Japanese by Yoshio Mikami.

Dr. N. L. Britton, of the New York Botanical Garden, accompanied by Mrs. Britton and Dr. Marshall A. Howe, of the garden, and Dr. C. F. Millspaugh, of the Field Columbian Museum, are at present conducting botanical explorations in the Bahamas. They expect to return at the end of the month.

Dr. L. A. Bauer left for Europe on February 1, to be gone five weeks on business connected with the department of terrestrial magnetism of the Carnegie Institution.

Assistant Professor Harry G. Wells, of the department of pathology and bacteriology, of the University of Chicago, is spending a year in Europe in the study of physiological and pathological chemistry. He is at present in Berlin.

Miss Clara E. Cummings, professor of botany at Wellesley College, sailed on February 1, for Jamaica, where she will spend several months in the study of the flora—particularly the lichens. Part of the time will be spent at the laboratory at Cinchona maintained by the New York Botanical Garden.

During holiday week Professors Gould and Woodruff, of the Department of Geology, University of Oklahoma, conducted a fossil collecting party into the Arbuckle Mountains of Indian Territory. The party secured about 2,000 specimens, among which are a large number of rare *Camerocrinus*. Most of these will be for exchange.

Mr. Chas. T. Brues, now with the Bureau of Entomology of the U. S. Department of Agriculture, has been appointed curator of invertebrate zoology in the Milwaukee Public Museum. Mr. Brues's address will change from Washington to Milwaukee on March 1.

Dr. Emanuel Kusy, Ritter von Dubrav, has been appointed head of the sanitary department of the Austrian Ministry of the Interior.

Mr. R. H. Lock has been appointed assistant curator of the herbarium at Cambridge University, succeeding Mr. Yapp, who was some time ago elected professor of botany at Aberystwyth.

Mr. Bailey Willis, of the U. S. Geological Survey, delivered two lectures at the Johns Hopkins University on January 18 and 19 on the results of his recent work in China under the auspices of the Carnegie Institution. Professor Wm. M. Davis, of Harvard University, will give in February a course of sixteen lectures on geographic subjects to the students of the geological department.

The following members of the assay commission, named by the President and Secretary of the Treasury for 1905, will meet in Philadelphia on February 8 to test the reserved coins of the various mints for the year 1904: Hon. Ellis H. Roberts, treasurer of the United States; Hon. W. B. Ridgely, comptroller of currency; Hon. J. H. Southard, M.C.; Hon. J. B. McPherson, judge, Eastern District of Pennsylvania; Dr. Herbert Torrey, U. S. Assay Office, New York; Milo M. Potter, Los Angeles, California; O. W. Thompson, Vermillion, South Dakota; Benjamin S. Hanchett, Grand Rapids, Michigan; Hon. Warren Truitt, Moscow, Idaho; Charles S. Winslow, Chicago; W. A. Blair, Winston-Salem, N. C.; Col. E. R. Sharp, Columbus, O.; L. A. Fisher, Bureau of Standards, Washington; Dr. John A. Mathews, Syracuse, N. Y.; Dr. Francis H. Smith, University of Virginia; Dr. Leonard P. Kinnicut, Worcester Polytechnic Institute; Dr. Edgar F. Smith, University of Pennsylvania; John Birkinbine, Philadelphia; Edward F. Stotesbury, Philadelphia; and W. H. Anderson, Grand Rapids.

Nature states that Sir James Dewar has presented the proceeds of the Gunning prize, amounting to one hundred guineas, recently awarded to him by the Royal Society of Edinburgh, as a contribution to the fund for the encouragement of research, now being founded in the University of Edinburgh in memory of the late Professor Tait.

Mr. William Sellers, well known as a mechanical engineer and manufacturer of machine tools, has died at Philadelphia, at the age of eighty-one years. Mr. Sellers was a member of the National Academy of Sciences and of the American Association for the Advancement of Science.

M. PAUL HENRY, the French astronomer, died on January 4, as a result, it is said, of cold in the Alpine Observatory on Grand-Montrouge. This was also the cause of the death of his brother, Prosper, who died in 1903. The brothers are well known for the work that they carried on together in astronomical photography especially in connection with the great international chart of the heavens.

PROFESSOR ERNST ABBE, of Jena, well known for his important improvements in the microscope and other optical instruments, which he constructed in partnership with Karl Zeiss, died on January 16, at the age of sixty-four years.

MR. THOMAS W. SHORE, a British geologist and archeologist, died on January 15.

MR. J. M. BACON, known for work in astronomy, acoustics and meteorology, and especially for his balloon ascents, died on December 25, at the age of fifty-eight years.

THE Department of Health of New York City has decided to establish a research laboratory in the new laboratory building which is being erected.

THE budget of the ministry of the interior of the German empire includes an item of $37,500 for research work on tuberculosis.

THE restored pterodactyl, with a spread of wings of twelve feet, first exhibited at the St. Louis exposition, has been set up for exhibition in Peabody Museum of Yale University.

Bird-Lore for February contains the annual report of the National Committee of Audubon Societies, a document of some eighty pages. The report summarizes the history of the Audubon movement and gives most encouraging details of the year's progress. Societies are now established in thirty-five states, and a model bird law has been passed in twenty-eight states. Thirty-four wardens to guard colonies of nesting birds are employed, and the societies cooperate with national and state game officials. President Roosevelt, who is in hearty sympathy with Audubon work, has set aside certain government lands as perpetual breeding places for birds, and the Lighthouse Board has lent its powerful aid in protecting sea-birds along the coast. The National Committee, which acts as an executive body for all the state societies, has recently become incorporated and proposes to attempt to raise an endowment fund of one million dollars, of which one hundred thousand dollars has already been promised.

BULLETIN No. 79 of the New York State Museum gives a comprehensive account of the mosquitoes occurring in New York State, with special reference to methods of control. Some 55 species are treated, the larvæ or wrigglers of 43 being described, with accounts of their habits and life history. Tables for the separation of adults and larvæ are given, and the value of the work is enhanced by over 100 original line drawings and 57 process plates reproduced from the author's photomicrographs. The keys and illustrations should enable physicians, and in fact almost any person having a fair microscope at his disposal to identify most of the common forms either in the adult or larval stage. This bulletin should also appeal to teachers interested in nature study since no group of insects lends itself more readily to class room conditions.

ACCORDING to the *British Medical Journal* the medical profession is fairly well represented in the senate of Canada as well as in the Canadian House of Commons. There are nine in the former and fifteen in the latter body. In the United States Senate there are only two, while there are none in the House of Representatives. France is still the country where medical men are most prominent in politics; in the Senate there are thirty-nine, and in the Chamber of Deputies fifty-one.

THE *Geographical Journal* states that an important expedition for the purpose of exploring the interior of Dutch New Guinea, organized under the auspices of the Netherlands Geographical Society, started early in 1904. The leader is Mr. R. Posthumus Meyjes, who has with him various assistants, including Dr. Koch as natural history collector. On the way out to the East, Mr. Meyjes stopped at Florence, where he met and consulted with Sir W. MacGregor, the naturalist; travelers Beccari and Loria, and Professor Giglioli. After the arrival at Batavia, some time was taken up in preparations, including arrangements for coolies, military escort, and so forth. Arriving at Merauke (New Guinea) on April 5, Mr. Meyjes did some preliminary work in the way of surveys and observations on the south coast of New Guinea, making a trip also to Thursday Island in order to connect his surveys with previously fixed positions. At the date of his last letter, Mr. Meyjes had returned to Surabaya and Batavia to make the final arrangements for the main expedition.

The *Scottish Geographical Magazine* is informed by Mr. W. S. Bruce that the Argentine relief ship *Uruguay* sailed from Buenos Ayres for the South Orkney Islands, to relieve the meteorological party at the station there about the middle of December. We may therefore expect the arrival of Mr. R. C. Mossman about the end of February. Progress is being made with the working out of the collections by various specialists, amongst whom may be named Professor J. Arthur Thomson, who is doing the Alcyonaria; Professor Hepburn, the histology of the Weddell seal; Dr. Waterston, penguin development; Mr. W. Eagle Clarke, the birds; Mr. R. M. Clark, the plankton; Mr. T. V. Hodgson, Pycnogonids and Isopods; Sir Charles Eliot, Nudibranchs.

Reuter's Agency is informed by the Pacific Cable Board that by an arrangement between the Washington and Sydney Observatories, with the cooperation of the telegraph administrations concerned, time signals were sent on New Year's Eve from the Washington Observatory to the Sydney Observatory. Mr. Lenahan, of the Sydney Observatory, reports as follows: "The first set of signals were received satisfactorily, the 3 P.M. contacts being recorded here at 3 hr. 0 min. 3/57 sec. The second set, only 30 signals, were received altogether, the 4 P.M. signal reaching here at 4 hr. 0 min. 3/66 sec. The third set was satisfactory, the 5 P.M. signal reaching here at 5 hr. 0 min. 2/76 sec. The fourth set was satisfactory, the 6 P.M. signal reaching here at 6 hr. 0 min. 2/55 sec., the final mean being 3/14 sec. Cutting out the second set, the mean gives 2/90 sec. This concludes the arrangements at present existing, and the rapid time in sending the great distance separating Sydney and Washington, over 12,000 miles, is a triumph to the electrical departments of the states concerned. With many thanks and every good wish for the new year." The signals through the Vancouver-Fanning cable, the longest cable span in the world (3,457.76 nautical miles), were sent by automatic apparatus, and were recorded, as they passed, at the Vancouver station on an instrument placed in the artificial line which balances the cable for the purpose of duplex working. The signals consisted of second contacts, omitting the 30th and last five of each minute, except the last minute of the hour, when the 30th and all after the 50th second were omitted, the circuit closing with a long dash on the even hour. The signals were sent for five minutes before the hour from 3 P.M. to 6 P.M., Sydney time, equivalent to midnight to 3 A.M. Washington time.

It is stated in *Nature* that the committee for the scientific exploration of Lake Tanganyika (consisting of Sir John Kirk, Dr. Sclater, Sir W. Thiselton-Dyer, Professor Lankester, Dr. Boulenger and Mr. J. E. S. Moore) has lately received news of the progress of its envoy, Mr. W. A. Cunnington, who left England in March, 1904, under directions to continue the researches carried out by Mr. J. E. S. Moore during his two expeditions to Lake Tanganyika. Proceeding by the Zambesi and Shiré route, Mr. Cunnington was most kindly received at Zomba by Sir Alfred Sharpe, who granted him the assistance of two native collectors. Mr. Cunnington had instructions to devote his special attention to the lacustrine flora and fauna of Lake Tanganyika, and, as he passed up Lake Nyassa, began his investigations in that lake, in order to be able to compare its products with those of Tanganyika. On Lake Nyassa Mr. Cunnington was able to get a good number of tow-nettings from different parts of the lake's surface, and obtained, on the whole, a large quantity of its characteristic phytoplankton, besides a considerable amount of zoo-plankton, consisting mostly of Copepoda, Cladocera and insect-larvæ. The temperature of the water of Lake Nyassa was observed to fall seldom below 70°, while the temperature at 76 fathoms below the surface was ascertained to be about three degrees higher. Mr. Cunnington arrived at Karonga, at the head of Lake Nyassa, at the end of June, 1904, and traveled on to Tanganyika by the ordinary route of the Stevenson road. His last letters from Tanganyika are dated at Vua, on October 29, 1904. He had obtained a dhow from Ujiji, which enabled him to make his stay at different places on the lake longer or shorter according as he found much or little to collect. A good series of fishes had been preserved, and many freshwater crustaceans. As regards the vegetable life, Mr. Cunnington had been much struck by the near resemblance of all the forms obtained in Tanganyika to those which he had collected in Nyassa, though he could not say that they were specifically identical. From Vua, Mr. Cunnington had arranged to cross to the east coast of the lake, and to go some distance further north before returning to the western shore. Mr. Cunnington may be expected to return to England before the end of the year.

The annual general meeting of the Association of Teachers in Technical Institutes was held at London on January 18. According to the London *Times,* the chairman, in opening the proceedings, said that the association had been constituted in October, when a committee had been formed for the purpose of drafting a constitution and rules. The purpose of the present meeting was to consider the constitution and rules which had now been drafted, and to elect officers for the association. They were all agreed upon the necessity for some association which should form a union of teachers in polytechnics and technical institutes of all kinds. Two hundred members had already joined; and he believed that when they had made a start and the association had become a national one they would have a very large number of members, and their body would play an important part in organizing tertiary education in this country. After the chairman's address, the members ballotted for the election of officers with the result that Mr. W. J. Lineham was elected chairman, Mr. J. B. Coleman, Mr. C. Harrap and Mr. S. G. Sterling, vice-chairmen, and Mr. J. Wilson, secretary. The following are the objects of the association, which were drawn up by the provisional committee, and agreed to after discussion: (*a*) The advancement of technical education generally; (*d*) the interchange of ideas regarding the methods of technical teaching; (*c*) the promotion and safeguarding of professional interests in such matters as tenure, salaries, pensions, registration, training and qualification of teachers, schemes of examination and inspection; (*d*) to lay the views of technical teachers before the various educational authorities and the public; (*e*) to enable teachers in technical institutes to cooperate as a body with other educational or scientific associations where desirable; (*f*) to render legal advice and assistance to members wherever possible and desirable; (*g*) to institute an employment bureau; and (*h*) to create a benevolent fund for needy members as soon as the society shall be strong enough to do so. It was further agreed that all teachers in technical institutes should be eligible for membership with the exception of those who are engaged solely in secondary school work, a technical institute being defined as any institution existing mainly for the teaching of science or art as applied to industries or crafts.

The London *Times* prints daily an extract from its issue of a hundred years ago. The first extract of a scientific character that we have noticed is from the issue of January 23, 1805, and reads as follows: "It is not long since we heard, from Prussia, of a variety of experiments for extracting sugar from the beet-root (*beta* of the *pentandria digynia* of Linnæus). We were told, that a square plot of twenty-four miles, in the dominions of Frederic William, were to be devoted to this produce; and that the kingdom, ever after, would be rendered perfectly independent of the West India Islands, for a supply of the saccharine material. Whether the controversy of P. Terentius, and Varro Atacinus, on the antiquity of the use of this commodity, be of any importance, we will not affect to determine, but we may venture to assert, that the discovery of M. Achard, for the preparation of sugar from the vegetable we have named, deserves not only the attention of the chemist, but of the politician, considering the expanded interests of Europe and Africa as connected with the state of the Western Archipelago. The method of M. Achard is as follows: The roots are first carefully cleansed from all impurity; they are then cut into small pieces, and exposed to the bearing of a powerful press. The sugar under this process exudes from the vegetable mass, and in this state it appears glutinous, and of a dark color. Besides the saccharine matter, it abounds with albumen, extractive matter, and other substances, which must be separated from it; and the only difficulty attending the operation, is the exclusion of these impure and redundant ingredients. To effect this, he mixes in a cauldron of tin, or of tinned copper, one hundred pounds of the extract, in the state we have described, with three ounces and six drams of the sulphuric acid diluted in about a pint of water. The ingredients are afterwards poured over into vessels, to remain for the space of twelve, eighteen, or twenty-four hours. Twelve hours is a competent interval for ordinary purposes, but twenty-four is more beneficial, and the acid prevents the sugar itself from undergoing any pernicious alteration. The next step is, to separate the sulphuric acid from the extract; and this is done, by incorporating with the sugar seven ounces and a half of wood ashes, and afterwards two ounces and six grains of slacked lime. By these means, the sulphuric acid will disunite from the albumen, and the ashes with the lime will separate the acid, which will appear in the state of an insoluble salt. The application of lime is not at all new in our sugar refineries, indeed, it is constantly employed to assist the crystallization. The only thing requisite to complete the process of obtaining sugar from the beet root, is to clarify the saccharine residuum, and this part of the operation is so generally understood, that no explanation is necessary."

UNIVERSITY AND EDUCATIONAL NEWS.

The Union Theological Seminary of New York City, one of the few theological schools of university standing, has received an anonymous gift of $1,100,000, which includes a site adjacent to Columbia University, where new buildings will be erected for the seminary.

Mr. Bradford Merrill, of the New York *World,* has made a statement on behalf of Mr. Joseph Pulitzer in regard to the school of journalism established by him at Columbia University. It appears from this statement that Mr. Pulitzer has decided that the school shall not be established until after his death. Mr. Merrill says: "To avoid all uncertainties or misconception, I may add that the endowment of the college is absolutely irrevocable, and its establishment beyond a shadow of doubt. The first million is already in the actual possession of Columbia University. The second million is legally provided for, as well as a still further voluntary sum not mentioned in any agreement. Even the nomination of the advisory board is made in an instrument that will take effect instantaneously at Mr. Pulitzer's death."

Mr. Andrew Carnegie's gift of $125,000 to Oberlin College for the erection of a library building, which we recently noted, was conditioned upon the raising of $100,000 for endowment. The gift of Mr. Carnegie makes up $300,000 of the $500,000 necessary to secure the $100,000 given by an anonymous Boston donor. To secure the latter, $200,000 must be raised by July 1, 1905.

Mrs. Goldwin Smith has given $20,000 to Cornell University.

By the will of the late Edward A. Goodnough, of Worcester, gifts are made as follows: $25,000 to Mount Holyoke College, $15,000 to Iowa College, $25,000 to the Huguenot Seminary in South Africa, $5,000 to Washburn College in Kansas, $10,000 to Drury College in Missouri.

Sir John Nutting, of Dublin, has given $25,000 to Trinity College for scholarships.

Dr. Eugene Park Cowgill, of the University of Missouri, was recently elected to the position of instructor in physiology, University of Kansas. He began his duties with the opening of the new year.

SCIENCE

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FRIDAY, FEBRUARY 17, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE THEORY OF RESPIRATION.**

I ASK you to consider with me a topic which is of fundamental interest to physiologists, whether they concern themselves primarily with animals or with plants. I take it the basal identity of the living matter in all organisms and of its metabolism needs neither demonstration nor emphasis at my hands. Nor do I need to lay stress upon the importance of respiration as one of these metabolic phenomena, since it has been recognized from the earliest period as indispensable to life. The phlogiston theory of the composition of the atmosphere had scarcely disappeared below the scientific horizon, before the fact was discovered that there occurs, in animals and in plants alike, an intake of oxygen and an output of carbon dioxide which is intimately related to their existence. This became obvious to man, of course, in his own experience, a very superficial study of the composition of the air inspired and expired from the lungs showing that it had lost oxygen and gained CO_2. This much of respiration was early recognized to occur also with the larger animals, and a few years later like observations were made upon plants by Priestley, and more accurately by Lavoisier and Ingenhouss. Even this knowledge of respiration was not possible before Priestley's discovery of oxygen in 1774, and the very remarkable revolution in chemistry that followed in the closing years of the eighteenth century. Yet

* Address of the retiring president before the Botanical Society of America, Philadelphia, December 28, 1904. Published simultaneously in the *Botanical Gazette*.

this disappearance of oxygen and formation of carbon dioxide are only the external indication of respiration, as has been long recognized.

RESPIRATION IN ANIMALS.

Upon undertaking a special consideration of this topic, I found it needful to examine the recent literature of respiration in animals, the aspect of the general subject with which I felt myself least familiar. I found, to my very great surprise, that animal physiologists have concerned themselves very little with the essential problems of respiration. They seem to have been diverted to the study of the mechanism of gas movements in the higher animals. The lungs, with their intricate structure of lobes, lobules, atria and air 'cells'; the box in which the lungs are located, with its complex muscular mechanism, and the very complicated mechanism of innervation for the voluntary and involuntary movements which it executes; the blood, and the physico-chemical relation of the gases that enter and leave it in the lungs, of those that come into it from the tissues and of those it gives up to the tissues—these are the topics that one finds exploited at length when he turns to the text-books. I diligently examined the most modern and most thorough text-books on animal physiology; such books as Foster's 'Physiology,' Stewart's 'Manual of Physiology,' the 'American Text-book of Physiology' and Schaefer's 'Text-book of Physiology,' but in them I found no treatment whatever, indeed no mention whatever, of the real problems of respiration, that is, of what is happening in the tissues, the processes of which these external phenomena are the sign. Yet this much-studied respiratory mechanism, which is so striking in the higher animals, is entirely wanting in the lower animals and in plants.

Not finding even a clue to the literature in the text-books, it was only after much search that I was able to discover that anything at all had been done; and it is *so* little that it is almost a negligible quantity. There is an obvious reason for this, besides mere interest in the more striking phenomena. I am intending, however, neither arraignment nor excuse, but a bare statement of what were to me rather surprising facts.

RESPIRATION IN PLANTS.

The knowledge of respiration in plants began about the same time—the close of the eighteenth century—and advanced rapidly on account of the notable revolution in chemistry which took place about this time. Ingenhouss, the Dutch naturalist, really ascertained and published in 1779 the chief external facts of respiration; at least he was able to state them essentially as they were known for twenty-five years after his time. In 1804 DeSaussure showed that growth is dependent on respiration; that respiration is more active in growing parts than elsewhere; that it is the cause of the loss of weight to which plants are constantly subject; and later, that the heat set free in flowers is related to the absorption of oxygen. Not until 1833 was respiration treated comprehensively, when Dutrochet expounded the subject, comparing the respiration of animal and plant and showing it to be fundamentally alike in both.

Now at this point there began two remarkable misconceptions. One was the confusion that arose between respiration and the manufacture of carbohydrates, which Dutrochet called 'diurnal respiration.' Of that I shall not speak, save to say that the great weight of Liebig's authority made this error persist for half a century.

RESPIRATION AND COMBUSTION.

The other misconception was engendered by the comparison of respiration to combustion. It had been observed by Lavoisier that the heat of the animal body was dependent upon respiration; the heat of the plant body was shown by DeSaussure to be related to a disappearance of oxygen; combustion consumes oxygen and produces heat; therefore, respiration is a sort of combustion. So the argument ran.

It is quite impossible to overestimate the influence that this conception has had on the study of respiration. The mischief it has wrought depends chiefly, perhaps wholly, upon a misconception of the actual mechanism of combustion, a process that has ever been the *bête noire* of chemistry, as the history of the 'phlogiston' theory well shows. To our changed conceptions of combustion I shall return later.

The idea of combustion, however, which dominated the argument I have cited, was that oxygen combined with carbon to form CO_2 and with hydrogen to form H_2O. It was most natural, therefore, to conceive that the food taken up by the organism stood to it in the same relation as does the fuel to the engine, and that what happens is an actual oxidation of the food immediately and directly; in fact, a process precisely parallel to the burning of the same food outside the body.

One evident outcome of that idea is the current classification of foods into plastic and dynamogenous, those which are useful in building up the body and those that are useful in producing heat within the body; into 'fattening foods' and 'heat-producing' foods. You are doubtless familiar with these phrases.

But if foods are 'burned' in the body it must be important to know how much oxygen enters it, and how much carbon dioxide and water leave it, so as to discern the ratio which exists between them. Plainly a basis for this must be a comparison of the differences between the combustion of foods outside the body and their 'combustion' within the body. Yet, strangely, this has not been made until recently. Without giving the full tables let me show the results arrived at by two observers, regarding two of the most common plant foods, glucose and tartaric acid. These observers assume, you will notice, that the processes are comparable. The results are stated as ratios of CO_2/O_2.

Food.	By combustion.	By respiration.	
		Diakonow.	Purjewicz.
Glucose	$\frac{100}{100}$	$\frac{130}{100}$	$\frac{95}{100}$
Tart. acid	$\frac{160}{100}$	$\frac{290}{100}$	$\frac{162}{100}$

Diakonow's whole series shows that in combustion the carbon dioxid was always less than in respiration; Purjewicz found, with the exception of tartaric acid, and even there the difference between his results and Diakonow's is in the same direction, that it was always greater, his results being absolutely different in significance from Diakonow's. And this is a good type of the results to be found in examining the literature! I am not now concerned in determining which set of results is correct, inasmuch as I believe both are valueless, since on the assumption upon which they are based neither can be interpreted.

RESPIRATORY RATIO.

Long before this sort of comparison was made, however, a voluminous literature arose which was concerned only with the ratio between the carbon dioxid given off and the oxygen consumed, and how this ratio was influenced by temperature, by light, by this kind of food or that, by mere hunger, or by starvation. This ratio, the so-called respiratory ratio or respiratory quotient, the plant physiologists really inherited from the animal physiologists, by whom it was devised with reference to the gaseous exchange that occurs in the lungs. This respiratory ratio has proved a veritable will-o'-the-wisp, leading investigators into a bog where their labors and their thinking were alike futile. For as a sign of what is going on within, the respiratory quotient is absolutely valueless, however interesting the facts in themselves may be. I could cite an indefinite number of investigations to indicate this. I select a few cases.

As long ago as 1885 Rubner showed* that the respiratory ratio varied in resting muscles at different temperatures.

At 8.4°	$\frac{CO_2}{O_2} = 3.28$
28.2	1.01
33.8	1.18
38.8	0.91

Von Frey and Gruber† showed that in a dog's muscle, with artificial circulation, contractions are accompanied by an increase in the carbon dioxid added to the blood, but they found this increase variable (46–10 per cent.) and *less than the corresponding absorption of oxygen*, so that the respiratory ratio became lowered during contraction. Tissot‡ showed that the production of carbon dioxid in excised muscles was increased if the muscle were killed by heat or were fatigued by prolonged stimulation. The output of carbon dioxid in such cases *was not related to the rate of absorption of oxygen*. Six years ago Fletcher,§ using Blackman's apparatus, the most intricate and accurate apparatus yet devised for following gaseous exchanges, showed that the evolution of carbon dioxid from excised frog's muscles is *independent of the amount of oxygen taken up during the period*. He distinguished in the production of carbon dioxid, first, a short period (about six hours), which he thinks dependent upon the presence of oxygen; and second, a long continued evolution of carbon dioxid 'due to chemical processes occurring spontaneously within the muscle, in which complex molecules are replaced by simpler ones, with the conspicuous results of the appearance of [sarcolactic] acid and of free carbon dioxid.' He adds: 'Under suitable conditions the occurrence of active contractions in an excised muscle is *not* accompanied by an increase in the rate at which carbon dioxid is yielded by the muscle,' though oxygen is abundantly supplied then by the blood. He does find, however, an increased formation of other decomposition products.

Chauveau and Kaufmann, as long ago as 1887, found that the output of carbon dioxid from the levator muscle of a horse's upper lip was greater during activity than during rest, and *contained more oxygen than that absorbed in same time*.*

A great number of researches of the same tenor can be found in botanical literature. A single example must suffice. In an elaborate paper Purjewicz shows† that the variations in the carbon dioxid produced and the oxygen absorbed during a given period under various conditions *are not parallel*, the amount of carbon dioxid ranging within far wider limits than the oxygen. Thus, the carbon dioxid varied from − 14 to 120 per cent. of the average; the oxygen varied from 0 to 48 per cent. of the average. Purjewicz, indeed, expresses his conviction that the res-

* 'Versuche über den Einfluss der Temperatur auf die Respiration des ruhenden Muskels.' *Du-Bois-Reym. Archiv. für Physiol.* **1885**: 38–66.

† 'Versuche über den Stoffwechsel des Muskels.' *DuBois-Reym. Arch für Physiol.* **1885**: 533–562.

‡ 'Recherches sur la respiration musculaire,' *Arch. de Phys. norm. et Path.* V. **6**: 838–844. 1894. Also 'Variation des echanges gazeux d'un muscle extrait du corps.' *Op. et ser. cit.* **7**: 641–653. 1895.

§ 'Survival respiration of muscle.' *Jour. Physiol.* **23**: 10–99. 1898.

* 'Le coefficients de l'activité nutritive et respiratoire des muscles.' *Compt. Rend. Acad. Sci. France* **104**: 1126–1132. 1887.

† 'Physiol. Unters. über Pflanzenatmung.' *Jahrb. wiss. Bot.* **35**: 573–610. 1900.

piratory ratio has no value as indicating the actual course of respiration, and would separate the taking up of oxygen and the production of carbon dioxid as two processes only indirectly related.

It is clear that such results as have been cited became difficult to reconcile with the idea that respiration is combustion, and so an attempt was made to evade the force of the facts, while maintaining the comparison, by introducing a qualifying term and speaking of respiration as 'physiological combustion.' This modification, however, blinks the difficulty; it does not remove it.

Before passing from this part of my subject I may mention another false conception, which is more or less directly dependent on the notion that respiration is combustion. One often finds respiration described as a gaseous exchange—the taking up of oxygen and giving off of carbon dioxid—a trade between the atmosphere and the body. Clearly this is another case of transferring the superficial interpretation of our own physiological processes to other organisms. The exchange that takes place between the tissues and the blood, between the blood and air in the lungs, gives the foundation, and the unessential phenomena of respiration become substituted for the essential. It would be quite as correct to describe photosynthesis as 'an exchange of gases,' for carbon dioxid is taken up and oxygen is eliminated. Yet no one ever thinks so superficially of this process.

ANAEROBIC RESPIRATION.

For three quarters of the last century it was supposed that the evolution of carbon dioxid could only occur when free oxygen was available. But in the early seventies Pflüger discovered what seemed a peculiar form of respiration. He found that a frog put into a vacuum continued to give off carbon dioxid; and presently the same phenomenon was observed by Pfeffer and others in plants. So firmly had the conception of combustion fastened itself upon physiologists, that when this anaerobic respiration came to be explained, it was supposed that certain molecules of organic matter within the cell gave up their oxygen to others, that they might thus be burned in the body furnace to yield energy. Hence arose the term intramolecular respiration.

The study of anaerobic respiration, misleading as this early interpretation of it was, has thrown in late years a very great light upon normal or aerobic respiration. Here is a process which results in the evolution of energy, and gives rise to one important end-product of aerobic respiration, viz., carbon dioxid; yet it early became evident that it could not be counted a process of combustion, at least in any sense in which combustion was then understood. Plainly the changes that were going on within the organism which enabled it to give off carbon dioxid when no free oxygen was to be had could only be a rearrangement of atomic groups within the molecule and the formation of products which were simpler than those from which they arose.

FERMENTATION.

The process of fermentation, first thoroughly explored by Pasteur, whose results have been much extended by the brilliant researches of Hansen and many others, are evidently related to those of respiration by the nature of the end products and the conditions under which the processes occur. Indeed when one compares the end products of respiration and of alcoholic fermentation he finds them to be identical in all respects. Other sorts of fermentation likewise yield many substances that are found originating in the metabolism of the higher plants.

We have, then, three modes of energy release, which are evidently closely related if not identical; aerobic respiration, anaerobic respiration and fermentation. Their relations, so far as was known in 1898, were stated by Pfeffer in his 'Pflanzen-physiologie' and need not be reviewed.

THE COURSE OF RESPIRATION.

In translating that work Ewart wrote (p. 519): "The actual course of respiration within the protoplast is quite obscure." Pfeffer himself says (p. 551): "Our knowledge of the inherent protoplastic mechanism is too incomplete to afford a sound basis for any theory concerning the phenomena of respiration." Fortunately, knowledge in the last six years has broadened, and I believe that it is possible now to see pretty clearly what the actual course of respiration is. Perhaps you will say, to foresee rather than to see—but hypothesis must outrun demonstration. The advances to which we are indebted for deeper insight are in three fields: (1) the chemistry of proteids; (2) the course of combustion, especially at low temperatures; and (3) the nature of anaerobic respiration, and its relation to aerobic respiration. Let me speak of these in order.

CHEMISTRY OF PROTEIDS.

A knowledge of the proteids, complex as they are, could only be obtained by a study of their decomposition products. Now there is a very remarkable uniformity in these decomposition products. No matter what the organism from which they are derived, no matter how simple they are or how complex, when broken up by the process of digestion, or by boiling with acids, they yield invariably a series of products which have become in the last few years much better known. These are amino- or amido-acids; such substances as leucin, tyrosin, arginin, glutamin, glycocoll, etc. Materials of this kind are invariably present, and certain ones are so invariably present that they can be used as the basis of distinctive tests for the occurrence of digestion or similar decompositions of proteids. This gave a clue to the nature of proteids which was followed by several observers, notably by Kossel, in the study of what are believed to be the very simplest proteids, because of the fewness and uniformity of the fractions into which they break up. These are the protamines. It has become clear from the study of these simple proteids that they are made up in somewhat the same way as the polysaccharides, that is by condensation, in this case linking together a series of the amido-acids. This is possible because the amido-acids have a peculiar construction. They are, so to speak, different on different sides. On one side is an acid group and on the other a basic group; and so the amido-acids can hang together in chains, or even be condensed or polymerized to make a simple proteid. Among the amido-acids, as in the carbohydrates, there are certain atomic groups, like CH_3, CH_2, CHOH, CH_2OH, COOH, etc., which recur again and again, and in such groups the possibility of replacing a hydrogen atom or a hydroxyl radicle by some other atomic group is very great.

Note, for instance, the comparatively simple acetic acid, $CH_3 - COOH$. If we replace one of the three H atoms by the amido group, NH_2, we have at once an amido-acid, glycocoll, $CH_2(NH_2) - COOH$, which is one of the sorts of material out of which proteids can be made. Out of an alcohol or out of a sugar we may get just the groups CHOH, CH_2OH, etc., from which these amido-acids may be constructed when nitrogenous substances are present to supply the amido group NH_2. Thus the mode of construction of the proteids has been found to show a likeness to that of the complex carbohydrates, and it has long been known that the carbon groups were very much alike in both. It further appears that when the proteids are digested by any organism they break down into these fragments, of one sort and another, the amido-acids, the amides, etc., which may be put together again in new form to constitute the peculiar proteids of that particular organism. We may thus get one proteid out of any other by the breaking up of the complex molecule and the rearrangement of its constituent fragments. This fragmentation is readily accomplished by the proteolytic enzymes, which probably act on these bodies as the diastases do on carbohydrates.

OXIDATION.

The second important line of progress has been in the study of the oxidation of carbon compounds at low temperatures. For our purpose the important facts which have only recently been developed are that the oxygen of the air does not combine directly with carbon or with carbon monoxide to form CO_2 or with hydrogen to form H_2O, as has heretofore been supposed.

As long ago as 1893 Dixon's researches* on explosive gases showed that molecular oxygen was by far the most effective of the atmospheric gases in *retarding* combustion. This surprising result could not be interpreted then, and only in the light of Traube's theory and the studies of Bone and others† on the oxidation of gases like methane and ethane at low temperatures has it been possible to picture the mechanism of such combustion. This has been done by Armstrong,‡ who (with Traube) claims that the substances do not undergo direct oxidation, but hydroxylation, *i. e.*, its hydrogen atoms are successively replaced by hydroxyl radicles, with consequent splitting into various intermediate products, such as carbon monoxid and hydrogen peroxid, carbonic acid and water being the end products. Armstrong says:

> There is little reason to suppose that changes take place at high temperatures in rapid combustions in ways very different from those in which they occur at lower temperatures. * * * The effective operation is not the mere blow due to impact or the vibration caused by this in the molecule, but the conjunction of compatible molecules and the consequent formation of composite systems within which change can occur. In so far as temperature influences the formation of compatible systems, either as regards their character or the rate at which they arise, temperature has an influence, but probably not otherwise.

I ask you to notice, then, that the process of combustion is now being interpreted in the light of changes like those which have long been known in organisms under the name of hydrolysis, and are the characteristic mode of action of enzymes. Thus, when starch is acted upon by diastase it is probably by repeated reactions between water, dissociated into hydrogen and hydroxyl groups, and oxygen, in other words by continued hydroxylation that it becomes ready to fall apart into a series of dextrines and finally into maltose. Diastase in some way facilitates this dissociation. Maltase takes up the task, and maltose, further hydroxylized, cleaves into two molecules of glucose. Then zymase may lend its aid and hydrolyze the glucose molecule into lactic acid, breaking the latter still further into carbon dioxid and alcohol.

The mechanism of the digestion of starch is not known in detail, though the various intermediate products have been fairly well studied. The usual assumption made is merely that water combines with the starch under the action of diastase. I have carried the theory a little further into detail,

* 'The rate of explosion in gases.' *Phil. Trans. Roy. Soc. London* A. **184**: 97–188. 1893.

† Bone and Wheeler, 'The slow oxidation of methane.' *Trans. Chem. Soc. London* **81**: 535–545. 1902; **84**: 1074–1087. 1903. Bone and Stockings, 'Slow combustion of ethane.' *Trans. Chem. Soc. London* **85**: 693–727. 1904.

‡ 'Retardation of combustion by oxygen.' *Chem. News* **90**: 25. 1904. 'Mechanism of combustion.' *Trans. Chem. Soc. London* **83**: 1088. 1903.

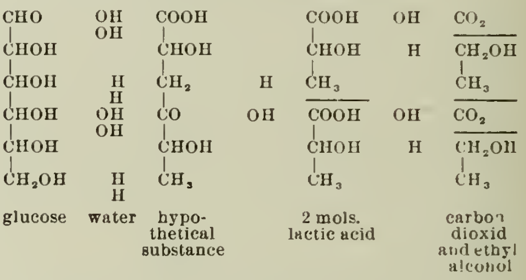
as seems warranted by the studies of combustion. It is worthy of note also that the late steps in the process, the hydrolysis of glucose by zymase, have been designated by the term fermentation. The combustion of starch has likewise not been examined, but as the end products are identical with those of digestion, it is not at all improbable that the intermediate steps are the same, though they succeed one another too fast to be followed by means at present available.

I need hardly remind you that our present ideas of the dynamics of chemical reactions forbid us to believe that such dissociation does not go on slightly at low temperatures, even when unaided. But it is so slow as to be ordinarily beyond our measurement. The enzymes seem to be mere accelerators of the several processes, perhaps preparing 'compatible systems,' as high temperature may do in combustion; perhaps entering into union with the substance they act on and forming compounds which are dissociable at ordinary temperatures in appreciable amounts.

The clue to an understanding of respiration has been found, therefore, not by comparing it to combustion, which was so long misleading, but by assimilating combustion to respiration. We may hope that chemists will restrict the term combustion or introduce a new one that will make more obvious the mode of action. Physiologists at least will do well to drop 'combustion' altogether from their vocabulary, as neither the past conception of it nor its probable use in the future conduces to clearness of thought.

NATURE OF ANAEROBIC RESPIRATION.

The third line of advance has been in a study of the relations of fermentation and anaerobic respiration. The first step was that long-sought discovery by Buchner, that the process of fermentation by yeast is brought about by the action of an enzyme which breaks up certain hexose sugars into carbon dioxid and alcohol. But a further step in advance has lately been taken. It appears from the work of Buchner and Meisenheimer* that the alcoholic fermentation is not direct, but that it occurs always in indirect fashion, as shown below.



Stěpanék has reached the same conclusion,† and Mazé‡ has found acetic acid as an intermediate product in alcoholic fermentation by a different yeast. The interest of the discovery that inactive ethylidene lactic acid is the intermediate substance in this process of fermentation lies in the fact that one of the two acids of which that is composed, namely, *d*-ethylidene lactic acid or sarcolactic acid, is formed as a product of respiration when proteids break down in the working, fatigued, or dying muscle. Fletcher observed this as a more prominent product of contracting muscles than carbon dioxid itself. Thus a regular product of fermentation is also formed in the ordinary course of respiration.

The analogy between anaerobic respiration and fermentation had been suggested early—even by Pasteur—and has thus been growing closer with each added bit of knowledge. But the precise way in which the destruction of the living substance went on in anaerobic respiration was still un-

* 'Die chemischen Vorgänge bei alcoholischen Gärung.' *Ber. Deutsch. Chem. Gesells.* **37**: 419–428. 1904.

† 'Ueber die aerobe und anaerobe Atmung der Eier.' *Centralbl. Physiol.* **18**: 188–205. 1904.

‡ 'Utilization du carbone ternaire.' *Ann. Inst. Pasteur.* **18**: 277–303. 1904.

known. Fermentation had been shown to be due to an enzyme. Was anaerobic respiration also due to an enzyme?

Of course enzymes are known to be present in a great many of the parts of plants, and the oxidizing enzymes seemed to be the sort to be sought. But none seemed to answer the conditions. At last, however, the object appears to have been attained. Stoklasa, in a series of papers published in various journals* but all dealing with the same general problem, declares he has found in various tissues of animals and in considerable number of plants an enzyme analogous to Buchner's zymase, and like it glycolytic. This enzyme he reports in leaves and roots of beet, tubers of potato, seeds, seedlings and young plants of pea, seedlings of barley, and entire plants of *Paris quadrifolia*. Confirmatory results have (naturally enough) been obtained by several students or assistants who have evidently been engaged upon portions of the problem under the guidance of Stoklasa. It is only fair to say that Mazé has strongly criticized Stoklasa's methods from the bacteriological side and declares himself unable to secure like fermentation under aseptic conditions; though Stoklasa claims to have guarded carefully against infection and to have rejected contaminated cultures. Independently, Mazé has found what he calls zymase, in connection with pea seedlings, *Aspergillus*, and *Eurotiopsis*. He declares it 'an enzyme normal to all plants, arising like all the other enzymes during vegetative (aerobic) life.' In the higher plants, however, and in most fungi it 'is oxidized with the greatest ease, so that one never finds more than a trace of it.'

Mazé and Stoklasa interpret their results somewhat differently, Mazé holding the process of fermentation to be a nutritive one,* sugar only being assimilable when fermented and the nascent alcohol thus made available, while Stoklasa believes fermentation to be merely anaerobic respiration and essentially a process for the immediate release of energy.

Confirmation comes also from another source, for Godlewski,† working with lupines, finds similar products, and concludes that their 'anaerobic respiration is identical with alcoholic fermentation, or at least in essence dependent on it.'

Moreover Kostytschew‡ and Maximow§ have found in *Aspergillus* an enzyme which is analogous to zymase and is responsible for the formation of CO_2, whether in aerobic or anaerobic respiration.

Thus several independent observers are testifying to the rather widespread occurrence of an enzyme which brings about a disruption of plant substance, under most varied external conditions, whether the

* Stoklasa, 'Identität anaerob. Atmung u. Gärung.' *Oesterr. Chem. Zeit.* 1903. (Not seen.)

Stoklasa, Jelinek and Vitek, 'Der anaer. Stoffwechsel der höh. Pfl. und seine Beziehung z. alcoh. Gärung.' *Beitr. z. Chem. Physiol. u. Path.* **3**: 460. 1903.

Stoklasa and Černý, 'Isolierung des die anaer. Atmung der Zelle der höh. org. Pfl. und Tiere bewirk. Enzymes.' *Ber. Deutsch Chem. Gesells.* **36**: 622–634. 1903.

—— 'Ueber die anaer. Atm. der Tierorgane u. ueber die Isolierung eines gärungserregenden Enzymes aus dem Tierorganismus.' *Zentralbl. Physiol.* **16**: 652–658. 1903.

Stoklasa, 'Ueber die Atmungsenzyme.' *Ber. Deutsch. Bot. Gesells.* **22**: 358–361. 1904.

Various papers in *Annales Inst. Pasteur* **18**: 1904.

* Iwanowsky in 1894 propounded the theory that alcoholic fermentation is a pathological case in the nutrition of yeast, called forth by the abnormal composition of the nutritive medium.

† 'Weiterer Beitr. z. Kennt. der intramol. Atmung.' *Bull. Acad. Sci. Cracovie* **1904**: 115–158. See also his earlier paper with Polzeninsz, *Bull. cit.*, April, 1901.

‡ 'Ueber Atmungsenzyme der Schimmelpilze.' *Ber. Deutsch. Bot. Gesells.* **22**: 207–215. 1904.

§ 'Zur Frage über die Atmung.' *Ber. Deutsch. Bot. Gesells.* **22**: 225–235. 1904.

plant be fed on one food or another,* this dissociation resulting in the formation of carbon dioxid and of various other products.

THE MECHANISM OF RESPIRATION.

Let us now focus the light coming from the chemistry of proteids, the mechanism of combustion, and the physiology of respiration, to form a picture of what goes on in the body.

First: We should conceive of the respiratory dissociation as taking place in the living material of the body and not in a food still unassimilated. Experiments with a wide range of foods have shown that they affect the intake of oxygen and the output of carbon dioxid in the most diverse ways, whence it has been assumed that the respiratory ratio varies because of the way in which the given food is oxidized. I do not say that it is not possible for the protoplasm to decompose a sugar directly or to oxidize a fat. But it must be remembered that in no case has it been experimentally proved that the food *is* directly attacked, and that all the facts can be explained on the other assumption, and some of them very much better than on the theory of direct oxidation. Moreover, the lability of proteids which have been raised to the life-level is their most striking characteristic as contrasted with their ordinary stability.

In such labile material the *second* step is easily conceivable. There occurs a shifting of the atomic groups within the molecule, perhaps as a result of the last step in their anabolism—the addition of hydroxyl groups from the water everywhere present. Dissociation follows necessarily; very slow perhaps, at ordinary temperatures and with a scanty supply of water, yet sufficient evidently for the maintenance of life. Such conditions may very well be those obtaining in resting organs, spores and seeds. But normally this cleavage may go on at a measurable rate, without anything more than the inevitable dissociation when hydroxylation has progressed to a certain point. It seems, however, that there is generally—perhaps always—a hastening of this process, and that the highly unstable protoplasm is dissociated so rapidly that it liberates not only the energy immediately utilized in growth, movement, etc., but also an excess sufficient to be easily measured by so coarse an instrument as the thermometer. Catalytic agents like the enzymes are certainly (I think I may be permitted so strong an assertion) the usual accelerators. And it is highly probable that an enzyme identical with zymase or at least analogous to it, is an active though secondary agent in this acceleration. It may very well be also that those changes outside the protoplast (whether without the organism or not) that are called stimuli accelerate still further the katabolism, even to an explosive speed in some cases.

This primary dissociation may plainly be independent of free oxygen, though it is hardly conceivable that there will not be some oxygen present unless the plant has grown under most unusual conditions, which one can scarcely realize experimentally. The products of this decomposition are not sufficiently known, nor is their precise character important for our discussion. Among them are certainly the more complex amido-acids, carbon dioxid and alcohol.

Third: Up to this point the respiratory processes are quite alike whether the plants grow in the air or apart from it. If sufficient oxygen be not present the disruptive

* See a paper by Kostytschew which has just come to hand ('Ueber die normale und die anaerobe Atmung bei Abwesenheit von Zucker' *Jahrb. Wiss. Bot.* **40**: 563–592. 1904), showing the erroneousness of Diakonow's idea that anaerobic respiration is only possible when sugar is supplied.

processes may reach an equilibrium, just as an electrolyte practically ceases to pass a current of electricity unless a depolarizer be present. So in the hydroxylation of proteids, there is needed some substance to disturb constantly, in one direction or another, the equilibrium that tends to be reached. The common agent in this is oxygen. Of course oxygen can hardly be the only depolarizer that can promote further action. Thus, Mazé found the presence of levulose conduced to the continued evolution of carbon dioxid in the absence of oxygen, and it is quite possible that levulose took up the rôle of depolarizer, though Mazé does not so interpret his observation.

In anaerobic respiration insufficient oxygen is supplied. Its products that have been most observed and are therefore (though doubtless groundlessly) counted its characteristic products, are carbon dioxid and alcohol. Indeed, lactic acid seems an equally characteristic though transient product. The fact that hydrogen has also been often recognized among them supports the interpretation of the function of oxygen just suggested, and accords thoroughly with the theory of hydroxylation. In that process hydrogen atoms from the dissociation of water would be left free in case there was insufficient oxygen to form H_2O_2.

Fourth: But if the organism can get an adequate supply of oxygen, the katabolism continues, some of the most complex previous products breaking up by hydroxylation and thermal cleavage. Among the fragments are undoubtedly some that lose in part those very groups in which sugars, alcohols, fatty acids, etc., are peculiarly rich. These are rebuilt at the expense of such foods, which therefore disappear as a result of respiration. That ethyl alcohol does not persist when oxygen is present may mean either that it is decomposed, or that in its nascent state it is assimilated in the rebuilding of proteids, for we have seen how easily acetic acid, one of its oxidation products, can be converted into an amido-acid, glycocoll, and be thus in direct line for reconstructive metabolism.

This in its fundamental features is the theory I have presented in lectures to advanced students since 1898, though always as more or less a speculation. For various details I am indebted to the recent literature already cited. Because it is capable of explaining the observed facts, which are sufficiently numerous to demand a coherent explanation, I conceive it to be entitled to the dignity of a theory. Time forbids the discussion of details, and many points have been considered that can not be here presented.

This theory maintains the direct relation of aerobic and anaerobic respiration, whose genetic connection was long since advocated by Pfeffer. Anaerobic respiration is the primary process in all organisms. Whether aerobic respiration occurs or not depends upon the availability of oxygen. The relation of fermentation to the process is not wholly clear; for although fermentation gives rise to the same products as anaerobic respiration, this may depend in part upon respiratory decomposition, such as has been described, and in part upon digestion, which, as Iwanowsky and Mazé think, render the alcohol from sugars available for assimilation. I am inclined to believe that in fermentation we deal with an exaggerated anaerobic respiration, the active ferments being plants in which zymase is produced in such amounts that it can attack sugars outside the organism and thus secure sufficient energy with a minimum destruction of the protoplasm.

ENERGESIS.

Finally, I may suggest that for didactic purposes it is desirable to have a word other than respiration to designate the disruptive processes by which energy is released, leaving respiration to designate the more superficial phenomena of aeration with which plant physiologists are little concerned. Perhaps the word respiration is already too firmly imbedded in literature to be so limited. It will at least do no harm to propose that the terms aerobic and anaerobic *energesis* be considered, to which fermentative *energesis* may be added if necessary.

Charles R. Barnes.
The University of Chicago.

THE AMERICAN CHEMICAL SOCIETY AND SECTION C OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The meetings were held in the John Harrison Laboratory of Chemistry of the University of Pennsylvania, with the exception of those of the Section of Agricultural, Sanitary and Physiological Chemistry, which were held in the Dental Hall of the university. On Wednesday morning, December 28, there was a short meeting of Section C for organization. It was presided over by Professor L. P. Kinnicutt. The following officers were elected to serve during the meeting.

Councilor—James Lewis Howe.

Member of General Committee—H. P. Armsby.

Member of Sectional Committee, 1905–1909—Wm. McPherson.

Local Press Secretary—J. M. Mathews.

Following the meeting of Section C there was held the first session of the Chemical Society. President Arthur A. Noyes was in the chair.

J. A. Parker read a resolution opposing the passage of the Mann Bill, now before Congress. The resolution was referred to the Committee on Patents and Patent Legislation, and was amended to read as follows:

Resolved: That the present patent law is sufficient protection to American inventors and American industries provided that it be so amended as to require that, in order to secure protection for the legal period, the inventor must operate his process or manufacture his product in the United States on a commercial scale within two years after the issue of his patent, and must continue to do so during the life of the patent.

Professor Edward Hart then read a paper on 'Some Present Problems in Industrial Chemistry.'

He first described the Louisiana sulphur deposits which recently began to yield sulphur at the rate of 16,000 tons monthly at a cost of less than three dollars per ton. He then took up in detail the imports, exports, production and consumption of the important heavy chemicals and showed that much progress has been made in the recent past in supplying our own markets with the domestic products. This progress was most marked in metal products, of most of which we are now the largest producers. Among instances of recent progress the discovery of Mr. Gayley that dry air gave much more economical results in the iron blast furnace was cited and it was shown that at the most moderate computation this meant an addition to our national income of nine million dollars. Among the problems to be attacked by the chemist the following were cited: (1) A cheaper method for burning cement, (2) a cheap substitute for rubber, (3) an artificial cheap nitric acid, (4) extraction of potash from feldspar, (5) utilization of titanium compounds, (6) the home manufacture of coal tar products.

The speaker was of the opinion that great progress had been made in chemical industry in quality as well as quantity of product, and that we should soon lead the world in this branch of industry.

After this Professor James Lewis Howe read a paper on 'Recent Progress in Inorganic Chemistry.' This appeared in the

January number of the *Journal of the Chemical Society,* page 62.

F. W. Clarke, as a member of the International Committee on Atomic Weights, and of the corresponding committee of the society, gave an account of the changes made in the atomic weights during the year. The report of the International Committee is published in the January number of the *Journal* of the society. It was discussed by W. A. Noyes, W. D. Bancroft, A. A. Noyes and R. C. Wells.

At the afternoon meeting, the address of Wilder D. Bancroft, the retiring vice-president of Section C, on 'Future Developments of Physical Chemistry,' was listened to with great interest. It was published in SCIENCE, January 13, page 50.

On Thursday morning there was another general meeting of the society, at which the following papers were read:

The Atomic Weights of Sodium and Chlorine: THEODORE W. RICHARDS and R. C. WELLS.

Very careful analyses and syntheses of sodium and silver chlorides, made with purest materials from many sources, were made by several methods. These furnished convincing evidence of weighable traces of impurity in Stas's silver, and minor errors in his methods of work. Many observations were made which must be considered in any investigation of the highest accuracy, concerning the occlusion of impurities by precipitates, and the solubility of precipitates. Nearly a hundred quantitative experiments were made, and of these thirty ranked as final determinations. The result for the atomic weight of sodium was 23.008, and for the atomic weight of chlorine 35.473, if silver is taken as 107.930; but evidence was obtained showing that this value for silver is slightly too large. Further investigations, connected with and suggested by this work are in progress. The authors are greatly indebted to the Carnegie Institution of Washington for pecuniary assistance.

The paper will be published in the 'Publications of the Carnegie Institution of Washington' and also in the *Journal of the American Chemical Society.*

The Present Condition of Analytical Chemistry: W. F. HILLEBRAND.

The author refers to the evidence that has accumulated during the past years, showing a condition in technical analysis in this country which calls for the earnest attention of chemists, and particularly of instructors of chemistry. An opinion seems to be gaining ground that faulty instruction is at the bottom of much of the trouble. This view the author is forced to regard as not unfounded, though he thinks the faults are more commonly those of omission than of commission. He regards it as of the greatest importance that students should be made to think at every step of what they are doing and why they are doing it, that they should be made to test their distilled water and reagents as a matter of course, both as to quality and quantity of contamination, so as to have definite knowledge regarding the magnitude of the errors in their work ascribable to these impurities; that they should be obliged to check the accuracy of their work by analyzing some fairly complex material like a limestone, cement or slag, the exact composition of which has been carefully ascertained. The committee on uniformity in technical analysis of the American Chemical Society will soon be ready to send to all applicants a standard limestone of known composition, so that instructors may test their own or their students' skill as analysts, and employers that of their employees. No good work can be done unless the workman has good tools and knows how, when and why to use them. Full recognition is given of the adverse conditions confronting many, if not most, chemists in technical laboratories, but the claim is made that the thoroughly grounded student will be better able to secure satisfactory results, even under adverse conditions, than the one who is taught only the quick methods of the mill or smelter, without any adequate knowledge of the pitfalls in his path and of the proper means of avoiding them. The one who is thoroughly grounded in the minutiæ of a few complex analytical procedures will be the better fitted to use and apply short-cut methods with judgment. An appeal is also made to chemists to aid the committee of purity of reagents of the American Chemical Society in securing a better quality of reagents.

Diet in Tuberculosis: Harvey W. Wiley.

The physician should select a menu adapted to each patient. The oils, especially cod-liver and olive oil, are most beneficial. Alcohol has a food value, and is, besides, a stimulant. Whiskey, brandy and other beverages have often been used to great advantage. Easily digested foods, such as milk, eggs, soups, rare meats, fruits and vegetables furnish a variety of palatable dishes. The great value of a correct diet is in helping the physician to carry the patient over a crisis by giving strength to overcome the predatory character of the disease.

Proper Diet for the Tropics: Harvey W. Wiley.

Less food is needed in the tropics than in temperate climates because less animal heat is required. Tropical fruits are perhaps the best general diet. Any large excess of protein is to be avoided.

The Ripening of Peaches: W. D. Bigelow and H. C. Gore.

A study was made of the composition of six varieties of peaches, including both early and late and of varying texture and flavor. Samples were taken at three periods, and, when possible, at four periods of their growth. First, just after the June drop; second, at the time of hardening of the stone; third, at the time of market ripeness; fourth, the time of full ripeness. The results were expressed both as percentage composition of the peaches and as grams per peach. The results obtained were compared with those obtained by the same writers in the study of the ripening of the apple. Unlike the apple, the peach has practically no starch and apparently no reserve material, at least in appreciable amount, which will increase sucrose after the peach is separated from the tree. Unlike the apple, therefore, there is no increase of sucrose after picking. There seems to be some inversion of the cane sugar with the formation of invert sugar, but such changes are not nearly so marked as in the case of the apple. Between the time of the June drop and the time of market ripeness the flesh of the peach is increased on the average about ten times, while the weight of the stone increases about seventy per cent., and the weight of the embryo ninety-five per cent. The total solids in the flesh increase about ten times in weight, the marc increases about three times in weight, although the percentage of marc in the ripe peaches was much less than in the green peaches. In the percentage composition of the peach the reducing sugar decreases throughout the life history, whereas the sucrose increases. The acid also increases from the time of the June drop until the peaches become ripe. The nitrogenous bodies, both in the form of albuminoids and in the form of amido bodies, decrease in percentage and increase in grams per peach. There appeared to be no evidence of the change of proteids into the simpler amides, or *vice versa*.

A fuller account of this work will be given in a Bulletin of the U. S. Department of Agriculture, Bureau of Chemistry.

The Liberation of Hydrogen during the Action of Sodium on Mercury: L. Kahlenberg and H. Schlundt. (Read by title.)

The results of the annual election were then announced, the following officers having been chosen for 1905.

President—F. P. Venable.
Secretary and Editor—Wm. A. Noyes.
Treasurer—Albert P. Hallock.
Councilors—W. F. Hillebrand, C. F. McKenna, H. P. Talbot, J. M. Stillman and E. H. Miller.

The reports of the treasurer, secretary, librarian and the different committees were then read.

At present the total number of members is 2,675, exclusive of 124 who have been elected but have not yet qualified. The net gain for the year is 247. The balance of current funds is $1,187.90. The committee on publications received 209 papers, of which all but 39 were accepted. The increase of about 300 pages in the *Journal* represents original work mainly.

The committee on duty-free importations stated that new and very favorable rulings had been obtained in regard to imports. The report of the committee on patent legislation has already been mentioned.

On Thursday and Friday the different sections of the society held meetings, at which the following papers were read:

PHYSICAL CHEMISTRY.

Arthur A. Noyes, chairman.

Freezing-point Depressions of Aqueous Solutions of Some Benzene Derivatives: E. H. Loomis.

The Behavior of the Bronzes: W. D. Bancroft.

Copper-tin bronzes containing more than 92 per cent. copper show no inversion temperature. Bronzes containing 75–92 per cent. copper show an inversion temperature at about 500°. The tensile strength and ductility of the first group of bronzes is affected but little by heat treatment, while heat treatment has a very great effect for the second group. The strongest bronze has a composition of about 80 per cent. copper and a tensile strength of about 72,000 pounds per square inch. It is composed of β crystals with just a small amount of α crystals. The most ductile bronze has a composition of about 90 per cent. copper and gives a 40 per cent. elongation for a rod one centimeter in diameter. It consists of α crystals with just a small amount of β crystals. This work is being carried on under a grant from the Carnegie Institution.

Hydrochloric Acid Concentration Cells: W. D. Bancroft.

Sodium amalgam concentration cells have abnormally high electromotive forces but this has been shown to be due to the heat of dilution and not to a dissociation of sodium in sodium amalgam. Hydrochloric acid and sodium chloride concentration cells with calomel electrodes have abnormally high electromotive forces; but only a relatively small portion of this discrepancy can be attributed to the heat of dilution. The balance must, therefore, be due to electrolytic dissociation.

Electrical Conductivity of Aqueous Solutions at High Temperatures: A. A. Noyes and H. C. Cooper.

Electrolysis of Chromic Chloride Solutions: H. R. Carveth.

The writer has studied the electrodeposition of the metal from chloride and sulphate solutions and finds that the current efficiency depends upon the amount of the chromous salt present. The nature of the anode solution has a very marked influence on the efficiency; this is partly explained by the reaction between the diffusing anolyte and the chromous salt in the cathode chamber. Attention is also directed to a number of important factors which have not hitherto been carefully controlled, although they affect the yield very materially.

The Efficiency of Centrifugal Purification: T. W. Richards.

The very great gain in time, labor and material effected by centrifugal draining and washing during the purification of crystals was demonstrated by quantitative experiments, and simple forms of apparatus were suggested which secure these advantages to the organic chemist or to the worker with small quantities of precious material.

Electro-stenolysis and Faraday's Law: T. W. Richards and B. S. Lacy.

It was demonstrated by quantitative experiments that the deposition of large quantities of silver electro-stenolytically in the middle of an electrolytic cell had no effect on the weight of the deposit of silver at the cathode, and, therefore, that Faraday's law still holds true under these peculiar conditions. This is of interest in its relation to the porous cup coulometer, although it is true that no electro-stenolytic deposits are observed on the cup under ordinary conditions.

These two papers will appear in the *Journal* of the society.

The Mercury Sulphocyanate Complexes: M. S. Sherrill and S. Skowronski.

The paper is published in full in the January, 1905, number of the *Journal* of the society.

The Solubility of Calcium Sulphate in Solutions of Ammonium Salts and of Certain other Salts: F. K. Cameron and B. E. Brown.

It is shown that the solubility curve for calcium sulphate-ammonium chloride has a maximum value corresponding to about 225 grams of the more soluble salt per liter, and about 10.9 grams per liter of calcium sulphate. From this point on, with increasing concentration of ammonium chloride, the solubility of calcium sulphate decreases, until in a saturated solution there is only 7.4 grams per liter calcium sulphate. The ammonium nitrate curve is similar to the ammonium chloride curve, the solubility being somewhat higher. Here again, with high concentrations with respect to the more soluble salts the solubility decreases until in a saturated solution of ammonium nitrate it is only about half as soluble as it is at the maximum point.

The authors give the data they obtained with a concentration of the solution with respect to calcium sulphate and other more soluble salts, such as the chlorides, nitrates and sulphates of sodium, magnesium and ammonium.

The Action of Water upon Calcium Phosphates: F. K. Cameron and A. Seidell. (Read by title.)

The Action of Solutions of Potassium Nitrate upon Tricalcium Sulphate: F. K. Cameron and J. G. Smith.

The authors studied the action of solutions of various concentrations with respect to potassium nitrate upon tri-calcium phosphate at a temperature of 20°, for various lengths of time and for various proportions of solid to solution. It was shown that increasing the concentration of potassium nitrate increased both the phosphoric acid and the calcium going into solution, but that the ratio of calcium to phosphoric acid steadily decreases until in saturated solutions of potassium nitrate the ratio is approximately that required by the formula of tri-calcium phosphate. It appears, therefore, that increasing the amount of potassium nitrate in the solution reduces the hydrolizing action of water, although the solubility of the substance steadily increases.

Molecular Attraction: J. E. Mills.

The article was a summary of work

already published (*Journal of Physical Chemistry,* June, 1904, and December, 1904) and of work along the same line yet to be published. An equation was deduced based upon the idea that the so-called cohesive forces between the molecules of a liquid could be entirely and quantitatively accounted for on the supposition of an attractive force between the molecules, the force varying inversely as the square of the distance apart of the molecules. The deduced equation was tested by an examination of twenty-five liquids over wide ranges of temperature and pressure. The measurements used were, for the most part, those made by Drs. Ramsay and Young and Dr. Young. The result undoubtedly allows the conclusion to be drawn that the intramolecular forces obey a law exactly similar to the law of gravitation, *i. e.,* the attraction between the molecules of any liquid varies inversely as the square of the distance apart of the molecules, does not vary with the temperature, and is a function of the number of molecules (mass) considered.

The results also point to the conclusion that the so-called molecular association, as in the case of water, is caused by this same molecular attraction and not by another force such as chemical affinity.

On Crompton's Equation for the Heat of Vaporization: J. E. Mills.

An equation proposed by Mr. Crompton (*Proc. Chem. Soc.* (London), Vol. 17, 1901), $L = 2RT \log e\ d/D$ (L is heat of vaporization, R is the constant of the gas equation, $PV = RT$, T is the absolute temperature, d and D are the densities of liquid and vapor, respectively) was examined. It was shown that the latent heats so calculated were invariably and usually very considerably too high at low temperatures where the vapor pressure is small, but at high pressure, as the critical temperature of the liquid is approached, the results are in excellent agreement with the true heats of vaporization. Some important results following from this equation were pointed out. The article was published in the *Journal of Physical Chemistry,* for December, 1904.

AGRICULTURAL, SANITARY AND PHYSIOLOGICAL CHEMISTRY.

Wm. P. Mason, chairman.

Interpretation of a 'Water Examination': Wm. P. Mason.

The paper will be published in Science.

The Water of Utah Lake: F. K. Cameron.

In this paper comparisons are made of analyses of Utah Lake water covering a period of twenty years. It is shown that the mineral content of the water is continually increasing, the water containing about 300 parts of total solids in 1883 against over 1,400 parts per million of solution at the present time. This increase is mainly due to sodium chloride introduced by the seepage waters from the surrounding irrigated areas, which areas have been brought under cultivation since the first analyses were made; second, by the diversion, for irrigation purposes, of mountain streams formerly entering the lake; and third, by the relatively large evaporation from so shallow a body of water.

Determination of Oxygen consumed in Water Analysis: L. P. Kinnicutt.

The amount of oxygen consumed by a given water depends on the method used for determining this factor. Analyses of many samples of water and sewage show that the results obtained by the two English four hour methods, the 'English official' and the 'Manchester,' agree very closely with each other.

The results obtained by the four modifications of Kubel's method, which are used in this country, are not only very different from the results obtained by the English methods, but give varying results, depending on the modification used.

We are able to make a rough comparison between the results obtained by the English methods, with those obtained by the modifications of Kubel's process, and compare with each other the results obtained by the four modifications of Kubel's process. To compare results obtained by the English methods with Palmer's modifications of Kubel's process, thirty minutes at 100° C., with potable waters multiply the former by two and one half; to compare with American Association for the Advancement of Science method ten minutes at 100° C., potable waters multiply by two, with sewage multiply by four; to compare with Public Health Association method, five minutes at 100° C., with potable waters no change, with sewage multiply by two and a quarter; to compare with Massachusetts State Board of Health method, two minutes at 100° C., with potable waters no change, with sewage multiply by two.

To compare in the same way with each other the results obtained by the modifications of Kubel's process the following table can be used, taking the results obtained by the M. S. B. H. method as unity.

	M. S. B. H.	A. P. H.	A. A. A. S.	Palmer's
Potable waters..	1	1.25	1.75	2
Sewage	1	1.50	2	2.50

Standard Methods to be used in the Sanitary Analysis of Water: L. P. Kinnicutt.

A paper showing that the results obtained in the sanitary analysis of water depend to a large extent on the method of procedure by which the various determinations are made, and that at the present time there is no conformity among chemists as to the method of procedure. A variation of one hundred per cent. in certain determinations, depending on the process used, is not uncommon. The only way of obtaining results which shall be comparable is to follow the lead of the official agricultural chemists of this country and adopt standard methods to be used in the analyses of potable waters and sewage.

Determination of Nitrites in Water: R. S. Weston.

Biochemistry of Sewage Purification, the Bacteriolysis of Peptones and Nitrates: S. D. Gage.

In the treatment of sewage by modern biological methods, a great variety of chemical reactions occur, all of which are caused directly or indirectly by the action of bacteria. It was shown that bacteria common in sewage disposal are able to produce ammonia from organic matter, to reduce nitrates to nitrites, to ammonia and probably to elementary nitrogen, to liberate nitrogen from solutions of organic matter and also to fix atmospheric nitrogen. Many sewage bacteria also probably produce the lower oxides of nitrogen as reduction products of nitrates, which oxides may play an important part in the further decomposition of the organic matter in solution either through catalytic action or by direct chemical reaction. The amount of ammonia and the amount of nitrates reduced vary widely with different classes of bacteria, as does also the character of the reduction products of the nitrates. It has been found that a majority of the bacteria common in sewage and in sewage disposal systems reduce nitrates and form ammonia from organic matter, although these two functions are not always synonymous with the same species. Furthermore, it was found that there was a close relation between the ability of bacteria to peptonize insoluble organic matter and the ability to reduce nitrates and to ammonify this organic matter, although many exceptions have been noted to this rule.

The paper will be published in the *Journal* of the society.

An Apparatus for the Rapid Estimation of Urea in Urine: F. C. ROBINSON.

A Comparison of Organic Matter in Different Soil Types: F. K. CAMERON.

A comparison is made of soils with different organic content and soils of various textures, colors, etc., and the conclusion is developed that the organic matter contained in soils is not a general type characteristic. Within any soil type, however, the content of organic matter can be correlated to color and other properties of the soil, and is an important characteristic.

Availability of Nitrogen in the Soil: G. S. FRAPS. (Read by title.)

Homicide by Aconite Poisoning and the Quantitative Estimation of Aconite in the Human Body: H. C. CAREL.

INDUSTRIAL CHEMISTRY.

Edward Hart, chairman.

Wood Turpentine: W. C. CARNELL.

Spirits of turpentine has, for many years, been made by the distillation of the refuse wood of the southern long-leaf pine tree. As much of it was made in a crude way and put on the market poorly refined, it is now almost generally regarded as something different from spirits of turpentine and has received such names as wood spirits, spiritine, turpentine substitute, stump turpentine, etc.

When this refuse wood is distilled by steam and the temperature kept sufficiently low, a product is obtained which can be refined by one redistillation and having all the physical and chemical properties of spirits of turpentine made in the regular way. Its color is water white. Odor, when first made, is somewhat characteristic; when several months old same as regular spirits of turpentine. Specific gravity, 0.862 to 0.876 at 15° C. Distillation, 90 per cent. comes over between 160° and 180° C. Evaporation at 100° C. Residue, 1.13 per cent.

If properly made the product obtained from the refuse is identical with the distillate from the turpentine dip.

The Detection of Rosin in Varnishes: A. H. GILL. (Read by title.)

Best Method for the Analysis of Refined Copper: G. L. HEATH.

The Education of Technical Chemists: I. A. PALMER.

The average good man who enters a commercial laboratory from one of our technical schools is deficient in an understanding of the elementary principles of chemistry and in a knowledge of the ordinary methods of analysis. Most of the manuals are of little assistance, and the rule of thumb man fails when required to devise new methods to meet certain conditions. The technical chemist should be a man of broad education, and as such stands a far better chance of promotion than one of poor training. Technical schools should require more rigid qualifications for entrance, and should not permit lax scholarship. The attempt to imitate commercial practice is of doubtful utility, for there is no time for it, and the ideas carried away by the students are often wrong ones. The technical school should give a broad education in the principles of applied science, with just sufficient laboratory and shop practice to illustrate these principles. The training of the head as well as the hand should be the object sought.

The Utilization of Fine Ores, Flue Dust, Stove Dust, Down-comer Dust, etc., in the Blast Furnace: J. C. ATTIX.

At large furnace plants vast quantities of these materials accumulate, especially where the furnace burden is made up largely of Mesaba or other fine ores or concentrates. Many plans have been devised for working these fine materials and quite a number patented.

Some of the materials used have been

tar, glue, molasses, lime, asphalt and cement, all of which have practically been abandoned.

The method here used is to mix the fine materials with soft coal in varying proportions of from 12½ per cent. to 50 per cent. by weight, and then coke the coal. The coal in coking thoroughly incorporates the fine materials, and when charged into the furnace carries them down beyond where they can be carried over mechanically by the blast, and down to the zone of reduction or fusion, making a self-fueling and in many instances a self-fluxing ore. The plan is applicable at any plant running three or more stacks, or wherever the by-product ovens are used, or wherever the coke is made at or near the furnace.

INORGANIC CHEMISTRY.

James L. Howe, chairman.

The Effect of Water on Rock Powders: A. S. Cushman.

The results of investigations on the effect of water on rock powders, which have been carried on in the Division of Tests of the U. S. Department of Agriculture, were given. It has been found that wet grinding increases the binding power or tendency of the particles to cement together. This effect seems to be accompanied with direct decomposition of certain constituents of the rock magma, which results in forming colloidal films on the particles. The word 'pectoid' is suggested to describe this condition. Most rock powders that have been ground wet show an alkaline reaction to indicators, but if the water is filtered out the reaction is not usually shown. This observation is in line with the well-established fact that coagulated inorganic colloids have the power of occluding the bases from solutions of neutral salts. The analogy between the reactions that take place when Portland cement, powdered glass and rock powders are acted on by water was pointed out.

On the Complexity of Thorium: Fritz Zerban.

The work done by Chas. Baskerville on the elementary nature of thorium was repeated under similar conditions and his results were confirmed.

In addition, the acetylacetonates of the three new constituents were prepared according to Biltz's method. The three substances obtained show all the same melting point, viz., 171° C.; by mixing them together, the melting point is not lowered. (Biltz made similar observations in the cases of neodymium and praseodymium.) But the acetylacetonates of berzelium, carolinium and new thorium differ in their chemical behavior towards alcohol. Determinations of the atomic weight which were carried out with the acetylacetonates by Biltz's method, assuming the formula $Me(C_5H_7O_2)_4$, resulted in 225 for berzelium and 239 for carolinium.

The metanitrobenzoates of carolinium, berzelium and new thorium, prepared by Neish's method, could not be obtained in crystalline form.

Thorium from Brazilian monazite sand was fractioned into three constituents in the same way previously applied to thorium from North Carolina monazite sand; the percentage of berzelium and carolinium, however, appeared to be smaller.

On the Detection of Hydronitric Acid and Hydrazine in their Inorganic Compounds: A. W. Browne.

A blood-red coloration is produced when ferric chloride is added in excess to a neutral or very slightly acid aqueous solution containing free hydronitric acid or its salts, or holding in suspension the comparatively insoluble lead, silver and mercurous compounds.* The color is destroyed by

* See Dennis and Browne, *Jour. Am. Chem. Soc.*, 26, 577 (1904).

acids, and to some extent by salts of organic acids. With the exception of sulphates, salts of the mineral acids in general have no effect. One part of N_3 in 100,000 parts of solution may be detected. Trinitrides must be separated from sulphocyanates and acetates, should these be present, before the addition of the ferric chloride takes place.

Hydrazine may be detected by making use of either of the following facts concerning its inorganic salts: (1) When heated with nitric acid they are oxidized, yielding hydronitric acid; (2) when treated with silver nitrite under proper conditions they yield silver trinitride.

Tungsten Hexabromide: F. F. Exner. (Read by title.)

Reaction between Zinc and Copper Sulphate: A. J. Hopkins. (Read by title.)

Non-Existence of Copper Hydroxide: A. J. Hopkins. (Read by title.)

Notes on the Absorption of Hydrochloric Acid as a Basis for Standard Solutions: A. T. Lincoln.

The author described a simple method, in which the amount of hydrochloric acid absorbed in a given quantity of water is determined by weighing, and gave results obtained by his students in using the method.

A New Burette Holder: A. T. Lincoln.

A New Method of Determining the Oxygen in the Air: I. W. Fay.

The apparatus consists of a stout glass tube, twenty-one inches long and an inch in diameter, sealed at one end and ground evenly at the other. Rods of phosphorus eleven inches long and one eighth inch in diameter are held in place at the closed end by a perforated rubber diaphragm one half inch thick. A paper scale, eight inches long and divided into 200 divisions, is glued to the tube so that the 200 mark is at the open end. The tube is kept full of water when not in use. For a determination, pour out the water down to the zero mark, close with a glass plate and invert in a small vessel of water. When the oxygen has been removed, replace the plate, turn the tube upright and read the volume of gas. Correct for the reduced tension of the gas when the tube is inverted. Then two divisions on the scale are equivalent to one per cent. of oxygen.

A Modified Westphal Balance for Use with Solids: F. N. Williams.

Reactions in Liquid Ammonia: E. C. Franklin.

Liquid ammonia resembles water in many of its properties, such as high specific heat, heat of volatilization, critical temperature and pressure, and high dielectric constant. Both are associated liquids, both combine with many salts, and both are good ionizing solvents. The reactions of acid and basic amides dissolved in liquid ammonia are closely analogous to the reactions between bases and acids in water, as shown by the general equations:

$$MNH_2 + AcNH_2 = AcNHM + NH_3,$$

and

$$2MNH_2 + AcNH_2 = AcNM_2 + 2NH_3.$$

Reactions of the types below were also studied:

$$AgNO_3 + KNH_2 = AgNH_2 + KNO_3,$$

$$Pb(NO_3)_2 + 2KNH_2 = PbNH + 2KNO_3 + NH_3,$$

and

$$BiI_3 + 3KNH_2 = BiN + 3KI + 2NH_3.$$

It was further shown that salts of mercury, arsenic, etc., when dissolved in ammonia undergo 'ammonolysis' in much the same way that they are hydrolyzed in water. A number of other points of resemblance were given. The article will appear in the *Journal* of the society.

ORGANIC CHEMISTRY.

James F. Norris, chairman.

Laboratory Instruction in Organic Chemistry: James F. Norris.

An account of the methods used by the author. Great stress is laid on the work in the laboratory, instead of spending too much time on lectures. An important part of the work is the identification of unknown pure substances and mixtures by a systematic study of class reactions and the determination of physical constants.

The Detection of Palm Oil when used as a Coloring for Fats and Oils: C. A. Crampton and F. D. Simons.

Methods are given for the identification of the presence of palm oil in cotton-seed oil which is to be used in the manufacture of oleomargarine. Also two colorimetric tests are given for its detection in oleomargarine itself.

The Detection of Renovated Butter: C. A. Crampton and F. D. Simons.

In this paper the difficulties attending the identification of this product were discussed. Notes were given concerning several recent and promising methods for its detection.

A Method for the Rapid Analysis of Sugar Beets: David L. Davoll, Jr. (Read by title.)

The Rapid Detection of 'Beading Oil' in Whiskeys: O. S. Marckworth. (Read by title.)

A Rapid Gasometric Method for the Determination of Formaldehyde: G. B. Frankforter and Rodney West. (Read by title.)

The Action of Permanganate and Sodium Peroxide upon Formaldehyde, with a Determination of the Heat of Combustion: G. B. Frankforter and Rodney West. (Read by title.)

Firpene, a Terpene and its Comparison with Pinene: G. B. Frankforter and Francis Frary. (Read by title.)

The Crystalline Alkaloid of Calycanthus Glaucus: H. M. Gordin. (Read by title.)

The Hydrocyanic Acid Content and Some Other Properties of Cassava: C. C. Moore.

Methylamine as a Solvent: H. D. Gibbs. (Read by title.)

The Oil of Thymus Vulgaris: W. O. Richtmann.

Investigated the influence of soil on oil of thyme (*Thymus vulgaris*). Plants grown on light sandy soil, well drained and somewhat elevated, yielded 0.20 per cent. of red oil containing 45 per cent. of thymol. Other plants grown on heavy clay soil, poorly drained, near the river level yielded 0.22 per cent. of oil. It contained 42 per cent. of thymol.

On Thursday evening Professor Arthur A. Noyes, the retiring vice-president of Section C, gave a most interesting address on the 'Preparation and Properties of Colloidal Solutions,' illustrated with many experiments. It was a valuable summary of the work that has been done in that field, and will be published in the February number of the *Journal* of the society.

On Friday morning there was a general session of Section C, presided over by L. P. Kinnicutt. The report of the committee on indexing chemical literature was presented by Dr. James Lewis Howe, and was referred to the council with the request that it be printed. The following papers were presented:

The Nature of Amorphous Sulphur: Alexander Smith.

It was shown by consideration of the change in mobility, the solubility, the dilatation and the absorption of heat, that there are two liquid states of sulphur. That forming the greater part of the liquid phase up to 160.1° is pale yellow, and mobile, its coefficient of expansion diminishes and its solubility in triphenylmethane increases as the temperature rises. This state is named S_λ. The form which constitutes the greater part of the liquid from 160.1° onward is deep-brown in color and very viscous. Its coefficient of expansion increases and its solubility in triphenylmethane diminishes as the temperature rises. This state is named S_μ. Amorphous sulphur is supercooled S_μ.

On the Constitution of Portland Cement and the Cause of its Hydraulic Properties: CLIFFORD RICHARDSON.

The paper was read before the Association of Portland Cement Manufacturers, June, 1904, and has been published in pamphlet form.

Bivalent Carbon: JAMES F. NORRIS.

An attempt to prepare compounds of the type $C\langle{}^{R}_{R'}$, analogous to CO, in which the radicals, R, will have the same energy as oxygen in carbon monoxide. In this way it is hoped to avoid polymerization into $R_2C = CR_2$.

The Need of Action Regarding the Adulteraiion of Foods and Drugs: LEON L. WATTERS.

A brief review of the subject, in which the need of legislation was illustrated by examples that had come under the notice of the author.

The members of Section C and of the society were invited to visit numerous manufacturing establishments. A list of these was published in SCIENCE, for January 6, page 5.

The visiting chemists unanimously tendered a vote of thanks to the University of Pennsylvania, and especially to Professor Edgar F. Smith, his associates, and to the proprietors of the establishments mentioned.

Dr. C. F. Mabery was nominated by the sectional committee to be vice-president of Section C for the New Orleans meeting and was elected by the general committee.

C. E. WATERS,
Press Secretary.

Transmitted by
CHARLES L. PARSONS,
Secretary of Section C.

SECTION F, ZOOLOGY, OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION F met for organization on December 28, but no papers were read until after the adjournment of the sessions of the American Society of Zoologists. The officers for the St. Louis meeting were as follows:

Vice-President—C. Hart Merriam, U. S. Department of Agriculture.

Secretary—C. Judson Herrick, Denison University.

Councilor—C. B. Davenport, Carnegie Institution.

Member of General Committee—C. H. Eigenmann, Indiana University.

Sectional Committee—C. Hart Merriam, E. L. Mark, C. Judson Herrick, H. F. Osborn, S. H. Gage, C. H. Eigenmann, H. B. Ward, Frank Smith.

For the New Orleans meeting H. B. Ward was elected vice-president and W. E. Ritter member of the sectional committee.

The sectional address by E. L. Mark, entitled, 'The Bermuda Islands and the Bermuda Biological Station for Research,' was not read on account of the absence of the author. Nineteen communications were presented.

Natural and Artificial Parthenogenesis: ALEX. PETRUNKÉVITCH, Harvard University.

Heredity of Coat Characters in Guinea-Pigs and Rabbits: W. E. CASTLE, Harvard University.

1. Albino coat and angora coat are recessive Mendelian characters in heredity in guinea-pigs and rabbits.

2. Rough, or 'Abyssinian,' coat is in guinea-pigs dominant over normal or smooth coat.

3. The three coat characters mentioned are independent of each other. Each may exist either apart from or associated with one or both of the others.

4. Accordingly, cross-breeding involving the three pairs of alternate characters results in the production ultimately of eight visibly different classes of individuals, but of twenty-seven really different classes.

5. The principle of gametic purity is realized in a general way but not absolutely, for cross-breeding induces variability in the intensities of characters.

6. The gametes formed by certain recessive individuals are prepotent. This prepotency is hereditary.

Tropical American Fresh-Water Fishes: C. H. Eigenmann, Indiana University.

The Early Development of Chordates in the Light of the Embryology of Ascidians: E. G. Conklin, University of Pennsylvania.

Owing to the high degree of differentiation of the egg and early cleavage stages of ascidians, the small number of cells present during gastrulation and organogeny and the known cell-lineage of the principal organs of the larva, the ascidian egg is the most favorable in the whole phylum of the Chordata for an exact study of the early development. Under these circumstances it is worth while to compare the development of ascidians with that of other chordates, whatever may be thought of their phylogenetic position in the phylum.

In ascidians the animal (maturation) pole of the egg finally comes to occupy a position between the anterior and ventral poles of the larva and the chief axis of the egg is antero-ventral and postero-dorsal in direction. In other chordates the axial relations of the egg and larva are not certainly known, but there is considerable evidence that *Amphioxus* and the frog are like the ascidians in this respect.

In ascidians, the frog and possibly in *Amphioxus* also the spermatozoon either enters the egg at the posterior pole or moves to this pole after its entrance; in the two former classes the copulation path of the sperm within the egg lies in the future median plane, though in the case of the ascidians this plane is not determined by the path of the sperm, but is already established before fertilization.

In ascidians the cleavage of the egg is bilaterally symmetrical; the same is the case with several other classes of chordates; the resemblances between ascidians and *Amphioxus* being especially close. Probably in all chordates with holoblastic cleavage the third cleavage plane cuts off four ectodermal cells at the animal pole; in ascidians the four cells at the vegetal pole are endodermal, mesodermal and neural plate cells.

In ascidians and amphibians the blastula and gastrula are bilaterally symmetrical and the closure of the blastopore takes place chiefly by the overgrowth of the dorsal lip; probably the same is also true of *Amphioxus*.

Among ascidians the chorda and neural plate arise from a crescent of chorda-neuroplasm which surrounds the anterior side of the egg and gives rise to the dorsal lip of the blastopore. In many respects this crescent resembles the 'gray crescent' of the frog's egg and it seems not unlikely that here and in *Amphioxus* also the chorda and neural plate arise as in ascidians. In all of these classes the neural plate comes from the outer layer of cells of the dorsal lip, while the chorda comes from its inner layer. In ascidians and the frog the anterior limit of the neural plate reaches about one third of the way from the equator to the animal pole; the same is probably true of *Amphioxus* also.

The mesoderm of ascidians comes from a crescent of mesoplasm which surrounds the posterior side of the egg just dorsal to the equator. The substance of the crescent is later infolded in the posterior and lateral lips of the blastopore and its anterior portion lies alongside of the notochord. There are no mesoblastic teloblasts here, but with this exception this condition closely resembles Hatschek's account of the origin of the mesoderm in *Amphioxus*. The method of origin of the mesoderm in the ascidians supports Rabl's theory that the peristomal mesoderm is primary, the gastral secondary, and that the latter is derived from the former.

The Skin, Lateral-Line Organs and Ear as Organs of Equilibration: G. H. Parker, Harvard University.

Equilibration, as exemplified by the upright position of man, is in part carried out through the eye, the ear, the sense of touch and probably other senses such as the muscle sense. It is a reflex involving sense organs and muscular response; hence the term '*sense* of equilibrium' is inappropriate. The lateral-line organs of fishes have been supposed to be organs of equilibration. Lee has shown that when the central end of the cut lateral-line nerve in the dogfish is stimulated, compensating movements occur in the fins; but these movements can also be called forth by stimulating the skin in regions where no lateral-line organs occur. Hence the skin is as much an organ of equilibration as the lateral-line organs. Both skin and lateral-line organs are, however, inferior to the eye and the ear as organs of equilibration. The lateral-line organs are stimulated by water vibrations of low rate, *i. e.*, six per second.

The ear of the squeteague consists of a utriculus with three semicircular canals and a sacculus containing a large otolith. The cavities of the utriculus and of the sacculus do not communicate with each other. When the utriculus and its semicircular canals are destroyed, the fish shows equilibration disturbances, but no loss of hearing. When the otoliths of the sacculi are made motionless by pinning them against the lateral (non-nervous) walls of the cavities in which they are, equilibrium remains normal but hearing is for the most part lost. In the fish ear the utriculus is the organ of equilibration, the sacculus that of hearing.

The skin, lateral-line organs and ears represent, figuratively speaking, three generations of sense organs. The oldest is the skin stimulated by varying pressures, such as are produced by irregular currents, and capable of initiating equilibration responses. From the skin have been derived the lateral-line organs stimulated by water vibrations of low rate, and also significant for equilibration. Finally, from the lateral-line organs have come the ears stimulated by water vibrations of a high rate and important for equilibration. The ear, unlike the skin and lateral-line organs, is differentiated for its two functions, the sacculus for hearing, the utriculus for equilibration.

Comparison of the Habits and Mode of Life of Amphioxus and Ammocœtes: S. H. Gage, Cornell University.

1. Both *Amphioxus* and *Ammocœtes* live in the sand completely covered. If the head is projected or the entire animal remains out in the water on top of the sand, it is a sign of insufficient oxygen, too great heat, or illness on the part of the animal.

2. By repeated and continuous observation day and night I am led to believe that when in good condition the two forms remain constantly under the sand day and night; they change their position in the sand from time to time, however.

3. In entering the sand from the water there is a swimming motion until a consid-

erable part of the body is covered, then there is a snake-like movement in the sand and the animal quickly draws itself completely under. With the *Ammocœtes* the process of entering the sand is performed slowly enough to enable one to see all the steps. With *Amphioxus* and *Asymmetron* the movement is so rapid in vigorous individuals that one can not see the details. They seem to enter the sand like an arrow. When the animal becomes weakened from any cause or weary by much swimming and entering the sand, the movements become sufficiently slow to enable one to follow the steps.

4. *Ammocœtes* always enters the sand head first. *Amphioxus* usually goes head first, but may enter the sand tail first.

5. Both forms feed continuously, the food being derived from the respiratory stream entering the common branchio-esophageal chamber. In *Amphioxus* the respiratory stream is produced by ciliary action. In *Ammocœtes* the stream is produced mostly by muscular action on the two folds of the velum.

6. From the manner of feeding in nature it is easy to carry on feeding experiments. Any food, if finely enough divided to pass the sieve guarding the hood or oral entrance, will find its way into the digestive tube.

7. While both these forms live normally under the sand, each has a free life—the *Amphioxus* in its beginning or larval stage, and *Ammocœtes* in its adult or terminal stage.

8. *Method of Capture.*—With *Amphioxus* in Bermuda the animals live most abundantly in places where there is a current. The depth of the water is not, apparently, of great importance, as they were obtained in depths of a few inches up to a depth of thirty to sixty feet. It is only necessary to scrape up some of the sand with a dredge or dipper and look over the sand. When exposed to the air the animals wriggle vigorously and then are easily seen. If they remain quiet, they are seen with difficulty, they look so much like the sand. *Ammocœtes* is taken in the same way. It usually lives on the edge of a stream and it is easy to shovel up the sand and mud and look it over. The wriggling movement helps here also, as the coloration of the animal and that of the sand are almost identical.

9. *Hardiness of the Two Forms.*—Both are very hardy, and hence it is easy to keep them in the laboratory. Food will be supplied by the water, or one may feed them any desired food, as cooked flour, finely divided yolk of hard boiled egg, etc.

10. It was found possible to keep *Ammocœtes* in the laboratory from four to six months without doing more than change the water occasionally. *Amphioxus* and *Asymmetron* were captured the middle of August in Bermuda, taken to Ithaca in fruit jars of sand and sea water, and in this way some of them lived until the first of December. This experiment shows, I think, that it is entirely practicable to have living *Amphioxus* for study and experiment in our northern and inland laboratories.

Vitality of Mosquito Eggs: John B. Smith, Rutgers College.

The salt marsh mosquito, *Culex sollicitans*, lays its eggs in the soft mud on salt meadows and these eggs may remain for months, losing nothing of their vitality. After lying dry for a long time a large percentage hatches within a few hours after becoming covered with water. The remainder lie dormant for a period long enough to enable the first lot to reach full growth and then, if they are yet water covered, most of them hatch. A few eggs of each brood lie over until the year following, and all the eggs of the last brood hibernate. The first spring brood of these mosquitoes is the largest of the season because it contains the accumulation of all the eggs remaining unhatched for any reason from the summer previous. Migrating adults of this first brood live until September and the additions from later broods give the impression of large summer broods, whereas, in fact, the late broods are less numerous than the earlier.

Light Organs of the Firefly, Photinus marginellus: Anne B. Townsend, Friends Select School, Philadelphia.

Investigations of physicists have shown the light of the firefly to be the most perfect known; not more than one one-thousandth of the energy expended is converted into heat. The nature of the process of photogeny has not been conclusively determined, although the theory which has most credence is that the light is caused by the oxidation, in alkaline media, of some substance produced by the photogenic cells. Radziszewski has found carbon compounds, similar to those found in living organisms, which are luminous under such conditions.

The purpose of the author's study has been to find what light the structure of the organs throws upon these theories. The light organs of the male *Photinus marginellus* are two plates lying directly upon the hypodermis of the fifth and sixth abdominal segments. These organs are made up of two clearly defined layers: the dorsal, in which the cells are filled with a dense content of opaque granules, and a transparent ventral, the truly photogenic layer. Within the ventral layer the tracheæ branch profusely in an arborescent manner. The vertical tracheal trunks with their branches are surrounded by cylinders of transparent tissue. Between the cylinders are parenchyma cells, irregular in size and outline, and containing fine granules. At the periphery of the cylinders the tracheæ send out fine tracheoles, without chitinous intima, which anastomose, thus forming a close network of thin-walled air capillaries. When fresh tissue is studied under a microscope in the dark room the light is found to be uniformly distributed through the area of this tracheolar network, the cylinders appearing as non-luminous spots. Crushed light organs placed in oxygen respond instantly with increase of brilliancy. The light extinguished by CO_2 reappears instantly when the tissue is placed in oxygen. Experiments with a ctenophore, *Mnemiopsis leidyi,* show similar results with oxygen. Tissue in alkaline solutions becomes brilliantly photogenic under the influence of oxygen. The light is wholly extinguished when tissue is placed in acid solutions and does not reappear when oxygen is introduced. When the acid solution is made alkaline, the tissue again becomes photogenic.

Color Nomenclature: R. M. Strong, The University of Chicago.

The color terms used in biology are neither logical nor precise. An attempt to reduce color terminology to something like a precise system was made by Ridgway in 'A Nomenclature of Colors for Naturalists * * *' (1886). This publication was useful, particularly among ornithologists, in securing more uniformity in the naming of colors, but it employed the color terms in common usage among artists, dye-makers, etc. There is no general agreement concerning the spectral positions of these colors, and samples taken from various sources show very great variations.

The color system advocated by Milton Bradley in his 'Elementary Color' (1895) is both logical and precise. It is founded upon six standards with definite spectral positions. These are red, orange, yellow, green, blue and violet. All other 'pure' colors are obtained by combining these; thus we get 'blue-green,' 'violet-red,' etc. Dull or 'broken' colors and shades and tints of the so-called 'pure' colors are produced by adding varying amounts of black and white. Mr. Ridgway has himself adopted this system and is elaborating it for practical work in biology.

Popular Knowledge of Common Birds: Edward L. Rice, Ohio Wesleyan University.

Statistics showing the number of common birds known by students electing work in bird study in Ohio Wesleyan University during the years 1902–1904. Data have been collected for 71 women and 55 men, both before and after the course. For ease in comparison a limited list of 75 species of birds has been used, the list containing all the very common birds except the English sparrow. The number of birds known at the beginning of the course was startlingly small, the average for the whole class being 21. The average record of the men (27) was decidedly above that of the women (17). About 12 per cent. of the students (14 women and 1 man) knew 10 birds or less. The lowest number reported was 4. No bird was known by all students, the robin (known by all but one) heading the list. Bob-white, crow, hummingbird, blue jay, red-headed woodpecker, bluebird, mourning dove and cardinal followed in order named. The record at the close of the course showed the following averages: for women, 45; for men, 56; for all students, 50.

Notes and Queries as to: (a) The Cerebral Commissures of the Elephant Shrew, Macroscelides; (b) The Brain and Heart of a Manatee, and what is believed to be the Smallest Known Sirenian Fetus; (c) The Brains of various 'Fishes,' including the Rare Japanese Shark, Mitsukurina; (d) The Swallowing of a Young Alligator by a Frog: Burt G. Wilder, Cornell University.

In the African *Macroscelides* G. Elliot Smith has described and figured the callosum as long, but the splenium as terminating in a point without the usual continuity with the mesal or commissural part of the fornix; his specimen was not perfectly preserved and the only example examined by the speaker has not enabled him to determine the facts; the apparent condition is unprecedented and difficult to explain; well hardened brains should be carefully sectioned. Just the reverse condition is presented by the brain of a manatee that was hardened within the cranium in 1885 by the continuous injection of alcohol; not only do the callosum and the fornicommissure constitute a single continuous area, but there is no sign whatever of the pseudocele ('fifth ventricle' or ventriculus septi pellucidi); other unusual features are the great size, especially the height, of the paraceles ('lateral ventricles'), the caudal extension that may, perhaps, represent the postcornu, and the decided ental elevation that converts the deep lateral (Sylvian?) fissure into a 'total' fissure. The heart may not differ materially from those previously examined, but its preparation by continuous alinjection displays to advantage the independence of the ventricular apexes which is characteristic of the sirenians. The fetus has the tail at less than a right angle with the trunk and the head is strongly flexed; between the two curvatures it measures about 55 mm., a little over 2 inches; it was figured and described in the *American Journal of Science*, in August, 1875, but has been commented upon only by Murie; the minute papilla on the ventral side of the tail has not yet been interpreted. The brain of *Mitsukurina* is probably now seen for the first time; most of the features are like those of other low sharks, but the olfactory crura are very long; the spiracles are far ventrad of the eyes, and not as figured in Jordan's example. The speaker has already published papers respecting the 'fish' brains exhibited, the *Polyodon* in

1875, the *Chimaera* in 1877, and the *Ceratodus* in 1887. Contrary to supposed conditions at the first date, the speaker now believes that in teleosts the olfactory bulbs are always solid, and that their hollowness in ganoids is a diagnostic character. Some progress has been made upon the peculiar conditions presented in the chimæroids, but much remains to be done with specimens specially prepared. Attention was again called to the ventral extension of the cerebral hemispheres in the dipnoans, and to their remote affinities with the ganoids. If the account by T. J. Parker of *Scymnus* (or *Scymnorhinus*) in 1882 is correct, that shark presents a nearer approximation to the ideal type of the vertebrate brain than any other form, but more specimens should be studied. There was submitted a dichotomous arrangement of the vertebrates above the lampreys, differing in some respects from that published in the *Proceedings* for 1887, and in the *American Naturalist,* Vol. 21, 913 and 1033. It is based mainly upon encephalic and cardiac characters. For the first time stress was laid upon the absence from all the holocephala of the rectal pouch which is a constant and peculiar feature of all sharks and rays.

The Feeding and Other Reactions of Actinian and Coral Polyps: J. E. DUERDEN, University of Michigan.

The paper describes the reactions of actinian and coral polyps to mechanical and chemical stimuli, founded upon experiments conducted in the Hawaiian Islands during a recent visit of the writer under the auspices of the Carnegie Institution. Studies similar to those of Loeb, Parker, Torrey and Nagel were carried out upon two species of actinians (*Cribrina*), preliminary to those upon the corals *Fungia* and *Favia.* The principal results are a demonstration of the important part played by mucus in the feeding and other processes of the two groups of polyps, the conditions governing the inhalent and exhalent currents of the stomodæum, and the movements of small and large particles over the disc. They may be summarized as follows:

1. Small, non-nutritive particles falling on the disc and tentacles become embedded in a superficial layer of mucus always present. They may remain there for some time, dependent upon the state of activity of the polyp. In the end the mucus is broken up into shreds or patches and, with the embedded particles, is wafted away by exhalent currents from the stomodæum.

2. Nutritive substances lead to an opening of the mouth, the establishment of an inhalent stomodæal current, and a more rapid secretion of mucus, surrounded by which the substances are indrawn into the digestive cavity. An inhalent current being established, objects are indrawn independently of their nutritive value.

3. In actinians the transference of food to the mouth is largely assisted by the movements of the tentacles, disc, and upper part of the column; but in corals the stomodæal currents, assisted by the secretion of mucus, are the principal agents. A complex system of mucous streams is beautifully shown in compound corals.

4. The movement of heavier particles over the disc is largely due to thigmotactic or recovery reactions on the part of the polyp. Attention is drawn to the importance of this in the conditions under which many actinians and corals live.

5. The correlation of the various reactions with the anatomical structure of polyps is considered, and comparison is instituted between the reactions of polyps as fixed radiate organisms with those of free bilaterally symmetrical animals.

Cœlosporidium blattellæ, sp. n., a Sporozoan Parasite of Blattella germanica: HOWARD CRAWLEY, Wyncote, Pa.

The parasite lives in the Malpighian tubules of the host. It originates as a minute cell with a few nuclei. There is no definite body form. Development follows the neosporidian type; *i. e.*, nuclear multiplication and spore formation proceed *pari passu* with vegetative growth. There are two developmental cycles, resulting in the production of 'round bodies' and of spores. The 'round bodies' are 1.5 to 2 microns in diameter and contain a very irregularly shaped nucleus. The spores are ellipsoidal, 5 microns long and contain a round, oval or dumb-bell shaped nucleus. The parasite occurs in enormous numbers, but does not appear to exert a deleterious influence on the host.

Descriptions of a New Genus of Tanaidæ and a New Species of Tanais, both from Monterey Bay, California: Harriet Richardson, Smithsonian Institution.

Isopods from the Alaska Salmon Investigation: Harriet Richardson, Smithsonian Institution.

An Unnoticed Organ of the Sand-dollar, Echinarachnius parma: Emily Ray Gregory, Wells College.

A study of the morphology of the sand-dollar has shown the presence of a blind-ending diverticulum of the intestine which passes around the body-cavity, giving off branches on the outer side. In the young animal it is frequently distended with sand, but generally only a few grains of sand are found in it in the adult. The organ appears to be of most importance to the young animal, but whether its chief value is in removing sand from the intestine at this time or in carrying it to the different parts of the body cavity, has not been determined.

Physiological and Morphological Changes during 860 Generations of Oxytricha fallax: Lorande Loss Woodruff, Columbia University.

A culture of *Oxytricha fallax* was carried on from October, 1901, to its death in July, 1903, at the 860th generation. A record of the daily rate of division of the four lines of the culture was kept, and showed that the organism, when subjected to a uniform diet of hay-infusion, passes through marked periods of greater and less dividing activity. The first period of great loss of vitality occurred at about the 230th generation and the culture was on the verge of extinction, when it was 'rejuvenated' by the use of extract of beef. The second depression-period resulted in the death of the culture. A study of some two hundred permanent preparations of individuals showed that morphological changes occur during the life-cycle. A vacuolization of the cytoplasm appears first, and then distortion and fragmentation of the macronucleus, and reduplication of the micronuclei beyond the normal number when the vitality is at the lowest ebb. A similar study was made on four other cultures of hypotrichous ciliata and the results compared.

The Groups and Distribution of the North American Species of Diaptomus: C. Dwight Marsh, Ripon College.

Diaptomus is a genus of considerable interest, as it forms the greater part of the plankton that is available for food for fish. It is assumed that the genus is derived from marine ancestors, but it has no very close relatives. Thus far no attempt has been made even to arrange the American members of the genus in groups. A study of the distribution of the species with our present knowledge throws some light on the probable phylogeny of the group. There are now known thirty species. The distribution is in general one of latitude, with the greatest number of species in the mountain region of the west. A study of the distribution, with a comparison of structural characters, leads to a grouping of the species under four heads, the *tenuicaudatus* group, probably, being the most primitive. The most important factors in the development of the various forms are temperature and isolation.

A Preliminary Note on the Snake's Tongue: EDITH M. BRACE, Western Maryland College.

The chief function of the snake's tongue seems to be connected with a sense of feeling that does not require the stimulus of contact, and may be a finer development of the sense that enables some people to avoid obstacles in the dark without touching them. The bifid tip and the numerous folds that lie behind the forking of the tongue serve to greatly increase the surface exposure. Beneath the epidermis and extending out into the folds there is a deep nerve plexus composed of multipolar cells whose ends are frayed out into extremely fine fibrils that interlace in every direction. From this plexus nerve fibers extend out between the cells of the epidermis.

C. JUDSON HERRICK,
Secretary.

DENISON UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

Palæontologia Universalis.—The third fasciculus of this important republication of old or obscure species of fossil organisms has arrived. These three parts of 75 species, figured and described on 161 sheets. This completes the first annual subscription, which is eight dollars. The first fasciculus of the second series will soon appear, and subscriptions should be sent to G. E. Stechert and Co., 129–133 West 20th Street, New York City. The editorial work is in the hands of D.-P. Œhlert, of Laval, France, secretary to the International Commission appointed by the International Geological Congress, at its eight meeting.

CHARLES SCHUCHERT.

THE contents of *The Journal of Comparative Neurology and Psychology*, for January, is as follows:

SOCIETIES AND ACADEMIES.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE New York Section of the American Chemical Society held its fourth regular meeting of the season at the Chemists' Club, Friday evening, January 6. The following papers were presented before the section:

The Application of Bismuth Ammonium Molybdate to Gravimetric Analysis: F. V. D. CRUSER and E. H. MILLER.

Portions of a standardized bismuth nitrate solution were precipitated by acid ammonium molybdate, under varying conditions. In order to get the solution barely acid, the use of congo red was found to be preferable to methyl orange. In washing the precipitate of bismuth ammonium molybdate, ammonium nitrate gave better results than ammonium sulphate. It was found that bismuth may be determined correctly by the ignition of bismuth ammonium molybdate to $Bi_2O_3 : 4MoO_3$, when the temperature of ignition is kept below a dull red heat, and that this method gives as good results as those obtained by the reduction and re-oxidation of the molybdium by potassium permanganate.

In determining bismuth by the evaporation of a nitric acid solution of bismuth nitrate, the operation must be conducted in porcelain, otherwise some bismuth trioxide is reduced by unburned gases passing through the platinum.

Recent Progress in the Chemical Department of the Geological Survey: F. W. CLARKE.

The Work of the Bureau of Standards: W. A. NOYES.

The work of the National Bureau of Standards is organized under three divisions and the first two of these divisions are subdivided into six sections each. The bureau is, first of all, custodian of the legal standards of weights and measures for the United States, these being, in accordance with an act of Congress passed in 1893, a standard meter and a standard kilogram. In addition to the verification of weights and measures for state and United States officials and for private parties, a large amount of testing of thermometers, of pressure, gas and air meters, of electrical instruments for measuring resistances and other electrical quantities, and of electric lamps, is done. In connection with this work many researches are necessary, and the most important of those now in progress pertain to methods of measuring high and low temperatures, the development of standard sources of monochromatic light for use with the interferometer, the study of polarimeters with reference to their use in examination of sugars imported into the United States, the study of the Clark and Weston cells as standards of electromotive force, the study of the silver voltameter and electro-dynamometer for an absolute measurement of electrical currents, the measurements of inductance and capacity in their bearing upon the measurement of alternating currents, and the development of an integrating photometer for the measurement of mean spherical illumination by electric lamps. The chemical division expects to take up the subjects of standards of purity for chemical reagents and of standard methods of technical analysis.

Last Year's Work and Future Plans of the Bureau of Chemistry: H. W. Wiley.

The lines of investigation relating to problems connected with the applications of chemistry to agriculture were pursued with little change during the year ending June 30, 1904. In order to secure economy as well as efficiency in this work an endeavor has been made for many years to collaborate with other scientific investigators in the problems which are under consideration. This has been particularly true in connection with investigations undertaken to determine the effect of environment upon chemical composition in sugar-producing plants. This work was confined for a long time to the evolution of a sorghum plant containing a high content of sugar and a low content of melassigenic substances. Later the same lines of investigations were applied to the sugar beet in a general way.

For lack of funds similar experiments authorized by Congress in the study of the effect of environment upon the composition of the cereal grains have not been pushed as vigorously as could be hoped. Nevertheless, numerous comparative determinations have been made of the effect of the environment on the protein content of wheat. These data, which have been collected over a period of several years, have for their chief purpose to indicate the general character of the study necessary to determine more accurately those conditions which affect so seriously the composition of the wheat kernel. The purposes which should be kept in view in the growth of wheat include those relating to the possibilities of panification. While it is generally true in the case of wheat that the gluten content increases *pari passu* with the content of protein, such is not always the case. The causes which disturb the equilibrium existing between the gluten and the protein are worthy of serious and careful study. The ultimate object of the studies which the bureau has now in hand is to indicate the conditions which are favorable to the production of a grain of any desired quality.

During the past year the demand which has been made upon the Bureau of Chemistry for information in regard to technical problems of a chemical character relating to the production of paper and leather has been very great. The diminishing supplies of raw material in the production of paper and the consequent increase in price have made the agricultural problem of the production of this material one of great importance. Forests suitable for the production of paper pulp are rapidly disappearing and the deficiency of the material which arises from this cause must be supplied from other agricultural sources. The fibers of many plants which have heretofore been used only as waste material offer promising sources of supply. Among these may be mentioned the Indian corn stalk, the cotton stalk, and the bagasse resulting from the manufacture of sugar and syrup from sugar cane. The importance of the supply of tanning materials and of the study of leathers in regard to strength, appearance and durability is also growing, and constant demands are made upon the Bureau of Chemistry for information on these points.

Most important of the new work which was undertaken during the past year is the inspection of imported food products. Problems connected with the use of artificial colors, glucoses and preservatives have also been studied with a view of making the law more efficient. In the food laboratory important studies have been made during the year on the composition of tropical fruits and fruit products.

In the road material laboratory extensive tests have been made of all the materials used in road construction, both physical and chemical. The relations of colloidal structure to plasticity have been made the subject of especial research, the results of which were communicated to the society at the Philadelphia meeting by Dr. Cushman.

In the insecticide and agricultural water laboratory investigations of insecticides and fungicides, in connection with the Division of Entomology and the Bureau of Plant Industry, have been continued and an elaborate investigation of the character of mineral waters offered for sale has been partially completed. The work on the arsenic content of papers and fabrics sold on the American market has been completed and published as Bulletin No. 86.

F. H. Pough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

'BERYLLIUM' OR 'GLUCINUM.'

There is apparently little difference of opinion between Dr. Howe and myself as to the facts upon which a claim to priority of 'beryllium' over 'glucinum' as a name for the element under discussion is based, and I am willing to leave the interpretation of those facts to chemists at large.

It has, I think, been supposed, by those of the profession who have not personally looked into the matter, that the oxide was named 'glucine' by Vauquelin himself. I understand that Dr. Howe in his reply to me in Science, for January 6, admits that Vauquelin did not name the element or the oxide; that he in fact would probably have liked to name it 'beryllia,' really adopting glucine in his fourth publication under virtual protest, and that the clause 'la terre du Béril' used by Vauquelin in place of a name was literally translated into German as 'Berylerde,' becoming a definite name, used to this day, before Vauquelin consented to the use of 'glucine.' I think also that he will not question the fact that when it came to the actual use of the terms themselves Wohler separated and described 'beryllium'* before Bussy prepared 'glucinium'† although they were but a few weeks apart. With this summary I am perfectly willing to leave the question of priority to the 'ninety and nine' who are already using the more preferable term.

As to usage, it is quite evident that Dr. Howe's closing remarks are intended as a pleasantry, as I hardly think he wishes to give the impression that kalzium, kolumbium, etc., are the custom in German chemical literature. He does not question that the major part of the literature is German nor that the Germans, Swedes, Danes, Russians, Dutch and Italians use 'beryllium' exclusively. Next to the Germans the French have the most articles to their credit and use 'glucinium' exclusively, but the impression which Dr. Howe seems to wish to convey, that this is the customary term in England and America, is not correct. He made a lucky find in the index of the *Journal of the Chemical Society* (London) for 1903, which does read 'Beryllium, see Glucinum,' for some unknown reason, for the one abstract to which it refers uses 'beryllium' solely both in title and in subject matter, and 'glucinum' does not appear in this journal in index or abstracts on the subject for several years previously, although the abstracts are frequently from the French. This journal apparently leaves the matter to the wishes of the author, for Pollock in 1904 uses again 'glucinum.' For at least five years

* *Ann. der Phys.*, 13, 577.

† *Journal de chim. medical*, 4, 453.

the term 'beryllium' has been used exclusively in the index of the *Journal of the Society of Chemical Industry* and, so far as I have noticed, in the subject matter as well. On the other hand, the *Chemical News* uses the two words interchangeably in its articles, abstracts and index, part of its articles being indexed under one head and part under the other, and, unfortunately, without any attempt at cross reference. In America only one original article has appeared on the subject in many years which has used 'glucinum.' The *American Chemical Journal* has used 'beryllium.' The *American Journal of Arts and Sciences* for some years has used 'beryllium' and it is here that some of the best articles have appeared. The *Journal of Physical Chemistry* uses 'beryllium.' The *Journal of the American Chemical Society* has allowed its contributors to choose, and one article and two abstracts have appeared on 'glucinum' since its publication.

To play on Dr. Howe's own words, I think that with American, English, German, Swedish, Danish, Dutch, Russian, Italian, etc., journals and chemists using 'beryllium,' we can afford to let the French cling to 'glucinium' (not 'glucinum') a little while longer.

It is true that the committee appointed by the American Association on the Spelling and Pronunciation of Chemical Terms did recommend 'glucinum,' and so far as I can find its members are about the only American chemists loyal to the term. I think it highly unfortunate that their recommendations as to spelling and pronunciation have not been more generally adopted in our chemical literature and language, but it is true they have not and in regard to 'glucinum' it is my humble opinion that they were wrong.

Charles Lathrop Parsons.

New Hampshire College,
January 23, 1905.

THE ENGLISH SPARROW AS EMBRYOLOGICAL MATERIAL.

Doubtless many readers of Science who conduct courses in vertebrate embryology, in which the chick is one of the forms studied, have spent laborious hours in mounting serial sections of embryos of from five to eight days' development. The chick embryo of this age has reached so considerable a size that, even though the sections be cut comparatively thick, a complete series will fill a large number of slides. Of course type sections may be selected, and slide-room thus saved, but it takes nearly as long to prepare such a selected series as it does to mount the entire series.

A convenient substitute for the later chick embryos may be found in the ubiquitous and generally disliked English sparrow. There are probably few localities where the nests of this little pest may not be found; frequently they are so numerous that a large number of eggs may be obtained without difficulty.

So far as size is concerned, the sparrow, even at the time of hatching, is small enough to section without especial difficulty, and at the stage corresponding to the eight-day chick it is so small that a complete series may be mounted on a comparatively small number of slides.

Many teachers have probably made use of this source of supply of material to illustrate some of the phases in avian development that are usually read about in the text-books without being studied in the laboratory, but there may be some who have not thought of this method of procuring material and at the same time of helping to reduce the English sparrow population.

The idea is not original with the writer, but he is sure that it is not patented.

Albert M. Reese.

Syracuse University.

DELUC VERSUS DE SAUSSURE.

To the Editor of Science: In his letter of December 29 (Science, 525, p. 111), Dr. Eastman, returning to the question as to whom priority in the use of the term 'geology' properly belongs, says:

> I am unable to see why Von Zittel was not scrupulously exact in his handling of facts when crediting Deluc with prior use of the term geology as compared with De Saussure.

His letter bears internal evidence that, like me, Dr. Eastman has been unable to obtain the 1778 edition of Deluc's letters, which alone can be assumed to prove that priority. If this is the case, he is not justified in assuming that his quotation from the edition of 1779 is identical in wording with the original statement in the preface of 1778. This quotation is: 'L'usage ordinaire a consacré le premier des ces mots (cosmologie) dans le sens où je l'emploie.'

Geikie's statement with regard to the 1778 edition is: "The proper word he admits should have been geology, but he could not venture to adopt it because it was not a word in use."

Eastman, assuming that the statement in the second edition was word for word the same as that in the first edition, says that Geikie's rendering is not justified.

I reply that his assumption is unfounded, for so prolific a writer would be more likely than not to vary the wording of his phrases on a second writing. But even if the assumption were correct, Eastman's own rendering, 'the word cosmology is more generally used in an equivalent sense' is as free in one direction as Geikie's in another.

Entirely aside from this question, which is somewhat on the hair-splitting order, it is to be observed that my statement was, that De Saussure was the first geologist (in the modern sense, as Dr. Eastman kindly added for me) to use the word geology in speaking of his science. There is no question that De Saussure was such a geologist. Let us see, then, what authorities like Von Zittel and Geikie think of Deluc in this regard.

Von Zittel qualifies him as a remarkably busy but flighty observer, and a fantastic scribbler whose publications have, for the most part, fallen into deserved oblivion. His use of the term geology he says is first suggested in the preface to a volume containing fourteen letters addressed to Queen Charlotte of England, whom he served for many years as reader and traveling companion. This preface, he says, makes the pompous announcement that the book will contain the groundwork of a cosmology or earth history, but when examined the letters are found to be mostly filled with long-winded descriptions of the lands and peoples visited and very little of what the preface promises.

Geikie classes him with Richardson, the believer in fossiliferous basalt, Kirwan and others of that ilk, and says:

But though these men wielded great influence in their day their writings have fallen into deserved oblivion. They are never read save by the curious student who has leisure and inclination to dig among the cemeteries of geological literature.

S. F. Emmons.

SPECIAL ARTICLES.

NOTE ON THE VARIATION OF THE SIZES OF NUCLEI WITH THE INTENSITY OF THE IONIZATION.

1. I shall use the word fog-limit, to denote the difference (δp) of pressure between the outside (constant pressure) aud the inside of the fog-chamber, to which sudden exhaustion must be carried in order that condensation may just occur in dust-free air saturated with moisture. It is obvious that if the fog-limit is to be used as a criterion, the result depends in all cases (cæt. par.) on the particular type of fog-chamber used and all statements are to refer to a given type.

2. Nuclei of any size may be produced in dust-free moist air by varying the time and the intensity of the exposure to X-ray or other similar radiation. A particular fog-limit and hence a particular size of nucleus is reached for each case until the fog-limit vanishes. Thus in my experiments for

Dust-free air (radium at infinity)				δp — 24.5
Radium (10,000 ×, in thin sealed glass tube)				
at 200 cm. from fog-chamber,				21.5
at 100 cm. " "				20 8
at 45 cm. " "				20.2
Radium, do., within the fog-chamber				19
X-ray bulb				
at 35 cm. from fog-chamber, exposure	2	min.		δp = 19
at 10 cm. " " "	2	"		18
at 10 cm. " " "	4	"		17
at 2 cm. " " "	2	"		15.5
at 2 cm. " " "	4	"		10
at 2 cm. " " "	10	"		vanishing
at 2 cm. (stronger radiation) "	5	"		5
at 2 cm. (still stronger radiation) "	5	"		below 4

To these may be added the fog-limits corresponding to the more gradual decay of excited radio-activity (radium 10,000 ×, in thin hermetically sealed aluminum tube placed for 15 or 30 minutes within the fog-chamber).

Radium present in fog-chamber		$\delta p = 18.5$
Radium removed.	3.5 hours after removal,	21
" "	21 " " "	22
" "	29 " " "	23

On leaving the fog-chamber for hours without interference, the fog-limit for the excited activity was found to be lower, the coronas (cæt. par.) larger than if but a few minutes elapse between the condensations. Thus it takes time for the induced activity to saturate the air within the fog-chamber with nuclei, and more time as its activity is weaker. Persistence in case of the larger (X-ray) nuclei must be reckoned in hours.

A little induced activity was obtained through the hermetically sealed glass tube (walls say .5 millimeter thick) vanishing completely in about fifteen minutes, to the fog-limit of dust-free air. The same radium in the hermetically sealed aluminum tube (walls say .1 millimeter thick) left an excited activity behind in the fog-chamber, vanishing in about forty hours gradually to the fog-limit of dust-free air. It seems, therefore, as if something besides beta and gamma rays passed through these relatively thick tubes. Leaving this for further examination* I need merely instance here the adaptability and sensitiveness of the condensation method for the present purposes, where, moreover, the coronas will indicate the numbers of nuclei produced under any given conditions.

2. The general facts of the preceding paragraph are inferred objectively if an X-ray bulb is placed near one end of a long condensation chamber of waxed wood and the effect of sudden exhaustion viewed broadside through plate glass windows.† The coronas obtained after short exposure are all roundish, but taper in diameter from a large size near the bulb to a vanishing diameter (apex) near the middle of the chamber, with all intermediate gradations of aperture in corresponding intermediate positions. All lie within two oblique lines symmetrically inclined to the horizontal axis and meeting near the middle. The pressure difference used is thus more and more in excess of the fog-limit as the line of sight is nearer the bulb. Beyond the apex, the pressure difference used is below the fog-limit. The number of nuclei within the given range of condensation, *i. e.*, above a certain lower limit of diameter, increases with the intensity of the ionization. Smaller nuclei occur throughout the chamber and particularly within the reentrant region left blank after condensation.

3. If the number of nuclei (n per cu. cm.) is mapped out in relation to the corresponding pressure difference, δp. the initial slopes of the curves obtained are steeper as the fog-limit is lower. Thus per increment of δp of one cm. of mercury above the fog-limit of the ionized medium, and decidedly below the fog-limit of dust-free air, I observed with

Radium in sealed aluminum tube within fog-chamber,	$\delta n = 12{,}000$
Radium in sealed glass tube within fog-chamber.	6,000
Radium in sealed glass tube, 45 cm. from fog-chamber, outside	4,000
Do., 200 cm. from fog-chamber	1,000
Dust-free air (δp above 24.5 cm., radium at infinity)	4,000

Hence, effectively, the gradation of nuclei is more even, finer, *i. e.*, with fewer gaps, as the fog-limit is low and the maximum size of nucleus larger; while for sparse distributions the steps from one nucleus to the next in the order of average size are relatively large. For a different medium, dust-free air, for instance, the gradation is characteristically different.

Carl Barus.

Brown University, R. I.

* An important question is here confronted: Can an induced activity having any period of decay (within limits) be produced by successive filtering of the contents of the sealed tube containing radium, through walls of different thickness of density. In such a case the induced activity (supposing that no emanation escapes) would be a kind of phosphorescence.

† *Am. Journal*, Vol. 19, February, p. 175, 1905.

CURRENT NOTES ON METEOROLOGY.

LONDON FOG INQUIRY, 1901–3.

The 'Report of the Meteorological Council upon an Inquiry into the Occurrence and Distribution of Fogs in the London Area, during the Winters of 1901–2 and 1902–3' has been issued, and is summarized in *Nature* for January 12, 1905. The investigation was carried on with the aid of the Metropolitan

Fire Brigade, at thirty of whose stations daily temperature observations were made at fixed hours. The majority of the fogs are found to be due to radiation during calm, clear nights. Others are due to the passage of warm air over a cooled surface, and a third group is identified as 'cloud' fog. Some fogs could not be included in any of these categories. These fogs were accumulations of combustion products in an almost calm atmosphere, and were termed 'smoke' fogs. A fog scale, based on the extent to which traffic is impeded by land, river and sea, has been established as a result of this inquiry. As a first step in the direction of greater precision in fog forecasts, a night service at the Meteorological Office is recommended. Forecasts issued at 5 A.M. would have a much greater chance of being verified than is the case with those now issued at 6 P.M., for fogs are chiefly caused by nocturnal radiation. Radiation depends largely on the state of the sky, and an observation of the state of the sky in the early morning would make it possible to give several hours' warning. The present forecasts rarely, if ever, contain any indication of the intensity of the fog to be expected. A detailed study of the distribution of temperature within the London area during fogs shows that the thickest fog is usually to be found in the coldest region.

MOSSES, TREES AND POINTS OF THE COMPASS.

A recent number of *Ciel et Terre* (December 16, 1904) contains a note on the orientation of moss growths on trees. It has been stated that mosses grow so much more frequently on the north sides of trees that a traveler who has lost his way in a forest can by this means determine the points of the compass. Lately, further investigation of this matter shows that the mosses grow by preference on the sides of the trees which, for one reason or another, are least likely to lose their moisture. On horizontal branches, the mosses usually grow on the upper side, because the water remains there most readily. The bases of the trunks are more moss-covered because they receive a larger quantity of water. The unequal distribution of light also plays a part.

MONTHLY WEATHER REVIEW.

The October, 1904, *Monthly Weather Review* (dated December 22) contains the following original articles and notes: 'Studies of Raindrops and Raindrop Phenomena,' by W. A. Bentley, illustrated by photographic reproductions; 'The Advancement of Meteorology,' by T. H. Davis; 'Thunderstorms at Tampa, Fla.,' by J. Bily, Jr.; 'Mount Tsukuba Meteorological Observatory,' by S. T. Tamura; 'September Floods in the Southwest'; 'Royal Meteorological Society'; 'Long-Range Forecasts,' by H. B. Wren; 'Seasonal Rainfall Régimes in the United States,' by V. Raulin; 'Tropical Storm of October 10–20, 1900'; 'The Dechevrens Anemometer: Cold Waves.'

NOTES.

The *Bulletin* of the Philippine Weather Bureau for July, 1904, just received, gives details of a remarkable rainfall which occurred on the eleventh to the fifteenth of that month. Between 8 A.M. of the twelfth and 11 A.M of the thirteenth the total fall at the Manila Observatory was 17.19 inches, a quantity much greater than the normal rainfall for July (14.89 inches), which is also the normal monthly maximum for the year. Three half-tone views show the character of the inundations in the city of Manila.

R. DeC. Ward.

SCIENTIFIC NOTES AND NEWS.

At the meeting of the Society of American Bacteriologists, held in Philadelphia on December 28, 1904, the following officers were elected: *President,* Professor E. O. Jordan; *Vice-President,* Professor S. C. Prescott; *Secretary* and *Treasurer,* Professor E. P. Gorham; *Council,* Professor F. G. Novy, Dr. Erwin F. Smith, Professor F. D. Chester, Dr. J. J. Kinyoun; *Delegate to the Council of the American Association for the Advancement of Science,* Professor W. H. Welch.

Officers for the Society for the Promotion of Agricultural Science have been elected as follows: *President,* Dr. H. P. Armsby, State College, Pa.; *Secretary* and *Treasurer,* Professor F. Wm. Rane, New Hampshire College, Durham, N. H.; *Executive Committee,* Dr. J.

C. Arthur, Purdue University, Lafayette, Ind.; Dr. W. J. Beal, Agricultural College, Mich.; Professor F. M. Webster, University of Illinois, Urbana, Ill.

The following eminent foreign physiologists have been elected honorary members of the American Physiological Society: Th. W. Engelmann, professor of physiology in the University of Berlin; A. Dastre, professor of physiology at the Sorbonne, Paris; J. N. Langley, professor of physiology, Cambridge University; C. S. Sherrington, professor of physiology, University of Liverpool; Fr. Hofmeister, professor of physiological chemistry at the University of Strasburg; J. P. Pawlow, director of the Physiological Laboratory at the Imperial Institute for Experimental Medicine, St. Petersburg.

M. L. Troost, honorary professor of chemistry at the University of Paris, is this year president of the Academy of Sciences in succession to M. E. L. Mascart, professor of physics at the Collège de France.

At the recent annual meeting of the Torrey Botanical Club Judge Addison Brown resigned the presidency after fifteen years of service. Dr. H. H. Rusby, of the College of Pharmacy, was elected as his successor.

A cablegram to the New York *Sun* states that Ambassador Choate on February 10 attended the annual meeting of the Royal Astronomical Society to receive the society's gold medal on behalf of Lewis Boss, director of the Dudley Observatory at Albany, N. Y. Professor Herbert Turner, who presided, paid a tribute to Professor Boss. He added that at present a feature of the world's astronomical research was the steady work done in the United States. It was a pleasure to the society for the third time in five years to recognize this work. Mr. Choate suitably acknowledged the gift on behalf of the recipient.

It is said that Professor Francis G. Peabody, Plummer professor of christian morals, has been selected by the University of Berlin to be Harvard's first lecturer under the arrangement recently entered into between Harvard and Berlin to exchange professors.

Mr. Robert T. Hill, accompanied by Dr. E. O. Hovey, of the American Museum of Natural History, and a corps of assistants, has left upon an expedition for the purpose of studying the geography and geology of the Western Sierra Madre of Mexico. The party expects to do valuable reconnaissance work in this interesting field in continuance of the investigations upon the mountains and deserts of the Southern Cordilleras, which Mr. Hill carried on for many years while associated with the Geological Survey, and of Professor Hovey's studies of volanic phenomena. The expedition is fully equipped for topographic, photographic and geologic work. It is financed by an anonymous New York capitalist.

Mr. Walter H. Gilbert, chief clerk in the president's office of Columbia University, has been appointed assistant secretary of the Carnegie Institution.

Dr. W. M. Wheeler, curator of invertebrate zoology at the American Museum of Natural History, will give, at Columbia University, during March, a series of lectures on the social insects—wasps, bees and ants.

Sir William Thiselton-Dyer, director of the Royal Botanic Gardens, at Kew, took the chair at the opening lecture of the year, delivered, at the West India Committee-rooms, London, on January 25, by Mr. W. G. Freeman, superintendent of the Colonial Economic Collections at the Imperial Institute, on 'The West Indian Fruit Industry.'

We learn from *The British Medical Journal* that the Danish government has issued a stamp bearing the head of the late Professor Finsen with the object of placing within reach of the poorer classes a means of subscribing to the national monument by which it is proposed to commemorate the work of the Danish investigator. On the occasion of the Christmas and New Year holidays the Danish postmaster-general also issued four million illustrated postcards. The profits on the sale of these postcards are to form the basis of a fund for the erection of a sanatorium for indigent consumptives.

Dr. Ludwig von Tetmajer, professor of technical mechanics in the Technical Institute of Vienna, died on January 31.

Dr. Alpheus S. Packard, professor of zoology and geology at Brown University, died on February 14, at the age of sixty-six years.

Five hundred dollars will be awarded by the College of Physicians of Philadelphia to the author of the best essay submitted in competition on or before March 1, 1906, on 'The Clinical and Pathological Diagnosis of Sarcoma.' Further information may be obtained by addressing Dr. Francis R. Packard, College of Physicians, Philadelphia.

The Colorado Experiment Station has recently purchased additional land, to extend its farm facilities and to use for the horse-breeding experiments to be carried on with the cooperation of the U. S. Department of Agriculture. The short course in agriculture at the college has proved successful, over one hundred students being in attendance. It lasted for two weeks.

The case brought by Kansas against Colorado is now being heard before the U. S. Supreme Court through a commissioner. The case involves the situation where the customs applicable to one set of conditions have been found to be inapplicable to those of another, for the riparian doctrine of England and the East is in conflict with the necessity to divert water for irrigation.

The state of Vermont, following the state of Connecticut, has passed an act making it obligatory to examine each year the eyes and ears of public school children.

The British Medical Journal gives further details in regard to the celebration of the hundredth birthday of Senor Manuel Garcia, which occurs on March 17. The anniversary is to be made the occasion of a great demonstration in his honor by laryngologists of every nationality, who will at the same time celebrate the jubilee of their specialty. The program, as far as at present arranged, is as follows: At midday a ceremonial meeting will be held at the rooms of the Royal Medico-Chirurgical Society, Hanover Square. The Spanish ambassador will attend to congratulate the illustrious centenarian in the name of the government of his native country, and addresses will be presented by the Royal Society, before which Senor Garcia read his paper entitled 'Physiological Observations on the Human Voice' just fifty years ago; by delegates of the Berlin, South German, French, Dutch and Belgian Laryngological Societies; by musical societies and by old pupils of the famous *maestro*. In order not to overtax the strength of Senor Garcia, the addresses will for the most part be only formally presented, and the whole duration of the proceedings will not exceed one hour. The meeting will conclude with the presentation to Senor Garcia of his portrait painted by Mr. John Sargent, R.A., at the request of admirers throughout the world, together with an album containing the names of the subscribers. In the afternoon a scientific meeting will be held in the same place for the purpose of giving foreign specialists an opportunity of seeing the methods of work and results of their British brethren. In the evening there will be a dinner, probably at the Hotel Cecil, at which ladies will be present, and it is expected that Senor Garcia will make a speech. Notwithstanding his great age, he is still fairly vigorous in body, and he was able to attend the annual dinner of the Laryngological Society on January 13. His mental powers are absolutely undimmed by age.

In Massachusetts numerous spring waters have been developed in the vicinity of large cities. The population of the state is largely concentrated in towns, and in all the larger municipalities water systems are maintained. Lake, stream and spring supplies are all utilized, although where the first two are used great precautions are necessary to prevent pollution. In the rural districts of the western or more hilly half of the state springs constitute in many instances the commonest source of water supply, but their use is by no means confined to that region. In fact, because of the absence of other satisfactory supplies, they are often of far greater economic importance in the eastern part of the state, where many of the waters are used in beverages, or bottled or sold in bulk as table waters. It is because of the economic value of the individual springs that the eastern counties are so well represented in the spring records kept by the United States Geological Survey and published in Water Supply and Irrigation Paper No. 102, entitled 'Contributions to the Hydrology of Eastern United States, 1903.' Analyses are given of spring waters at South Wellfleet, Danvers, Arlington, Chelmsford, Coldspring, Framingham, Quincy, Sharon, Hanson, Hingham, Marshfield, Norwell, Scituate, Whitman and Hubbardston. Many interesting details are also added regarding the characteristics of these various waters. Owing to the cooperation of Mr. F. A. Champlin, a driller, the records of Massachusetts wells are also unusually complete. It is hoped that other drillers in this state and other states may care to keep a record of the wells they drill, and be willing to supply the survey with data showing the date on which each well was drilled, the situation of the well, how the water was obtained, the depth of the open portion of the well, the depth of the drilled portion, the total depth of the well, the depth to water, the depth to rock, the supply per minute, the use to which the water is put, and the cost of the work.

UNIVERSITY AND EDUCATIONAL NEWS.

In his last report President Eliot recommends the collection of $2,500,000 as an endowment for the college of Harvard University, and it is said that the alumni are making efforts to collect this sum before the next commencement day. The class of 1880 expects to contribute $100,000 on the occasion of its twenty-fifth anniversary.

Mr. Andrew Carnegie has given to the Rensselaer Polytechnic Institute at Troy $125,000 toward rebuilding the main building which was burned last June. He has also given $100,000 to Tufts College for the erection of a library building.

The trustees of Stevens Institute of Technology in Hoboken have decided to proceed with the construction of the proposed Morton Memorial Chemical Laboratory as soon as possible. The sum of $91,000 has been raised and $4,000 is available in unpaid subscriptions. It had been planned to spend $100,000 for the building and site. The proposed building will contain a memorial room in which will be placed souvenirs of the late president and other members of the faculty who have died.

Columbia University has established a course in chemical engineering leading to the degree of chemical engineer. The university has received a gift of $10,000 to equip a laboratory of electro-chemistry.

Mr. Edward Whitley, of Trinity College, Oxford, has given £1,000 to the university towards the endowment of a chair of pathology.

The Johnston Scholarships, founded at the Johns Hopkins University by the late Mrs. Harriet Lane Johnston, in memory of her husband and two sons, have been awarded for the current academic year as follows: The Henry E. Johnston scholarship to Solomon Farley Acree, B.S. (Texas), Ph.D. (Chicago), in chemistry; the James Buchanan Johnston scholarship to Henry S. Conard, A.M. (Haverford), Ph.D., in botany; the Henry E. Johnston, Jr., scholarship to Isaac Woodbridge Riley, A.B., Ph.D. (Yale), in philosophy. The stipend of each of these scholarships is the income of $30,000. They are offered primarily to young men who have given evidence of the power of independent research, and the holders are expected to devote themselves to advanced study and to research in the Johns Hopkins University.

Mr. Omar Ray Gullion has resigned his position as assistant in physiology at the University of Missouri to accept an instructorship in pharmacology at Cornell University.

The University of Wisconsin will next year give instruction in meteorology under Mr. James L. Bartlett, observer at the University station of the U. S. Weather Bureau.

The new chairs of helminthology and protozoology at the London School of Tropical Medicine have been filled by the appointment of Mr. Robert Thomson Leiper to the former and Mr. W. S. Perrin to the latter.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE PROBLEM OF DEVELOPMENT.**

THE selection of such a subject as the problem of development for a general address to this academy as a whole suggests a word of explanation. Within the privacy of our sectional meetings we are permitted to dig and delve as much as we please among the dry bones of specialization; but on this occasion a righteous tradition imposes upon the president the duty of laying aside his special tools in order to address the whole scientific body over which he has for a time had the honor to preside. In offering a brief general dis-

* Annual address of the president, New York Academy of Sciences, December 19, 1904. The critical reader will, I hope, be willing to bear in mind the conditions under which this address was delivered. My endeavor was to convey to a scientific body, composed only in part of biologists, some individual impressions of a student of embryology and cytology regarding the general bearings of recent researches in his special field. It was not consistent with this purpose to give a critical résumé for biologists, nor could authorities be cited in detail. The general conception here developed will recall certain views contained in Driesch's 'Analytische Theorie der organischen Entwicklung,' published in 1894 (themselves traceable to earlier conclusions of de Vries), but afterwards rejected by him in favor of an explicit theory of vitalism. The rediscovery of Mendelian inheritance, the newly produced evidence, on the one hand, of morphological and physiological diversity among the chromosomes; on the other, of protoplasmic prelocalization in the egg, have, however, placed the whole problem in a new light. I wish to acknowledge my indebtedness to Professor Whitman's fine essays on the questions that center in Bonnet's doctrines, published in the 'Wood's Hole Biological Lectures,' for 1893, which suggested the quotation from Huxley.

cussion of some latter day problems of embryology and cytology I shall endeavor not to violate the spirit of this tradition. The task is not an easy one, owing to the complexity of the data and their strangeness to those who have not closely followed the details of modern biological work; yet I am encouraged to make the attempt by the belief that the problem of development belongs to those larger scientific questions that are of enduring interest to all students of nature. It is only fair to point out, however, that a consideration of recent advances in this subject necessarily and speedily leads us into a region that lies remote from everyday experience, surrounded by arid wastes of technical detail, and inhabited by folk who speak an uncouth foreign tongue. With the best of intentions, therefore, the native guide and interpreter has need of some forbearance on the part both of his countrymen and of the outlanders whom he attempts to lead.

I need not dwell on the absorbing, almost tantalizing, interest with which the problem of development has held the attention of naturalists from the earliest times. Twenty centuries and more have passed since Aristotle first endeavored to trace something like a rough outline of its solution. The enormous advances of our knowledge during this long period have taken away nothing of the interest or freshness of the problem; they have left it, indeed, hardly less mysterious than when the father of science wrote the first treatise on generation. I will not dwell on the epoch-making work of Harvey, Wolff and von Baer, or the curious, almost grotesque controversies of the eighteenth century, when embryology invaded the field of philosophy and even of theology. I will only point out that even at that time, when embryology was almost wholly limited to the study of the hen's egg, embryologists were already occupied with two fundamental questions, which still remain in their essence without adequate answer, and though metamorphosed by the refinements of more modern observation and experiment still stand in the foreground of scientific discussion. The first of these is the question of preformation *versus* epigenesis—whether the embryo exists preformed or predelineated in the egg from the beginning or whether it is formed anew, step by step, in each generation. The second question is that of mechanism *versus* vitalism—whether development is capable of a mechanical or physico-chemical explanation, or whether it involves specific vital factors that are without analogy in the non-living world. It is especially to some modern aspects of these two questions that I invite your attention; and I shall also consider briefly their relation to recent conclusions affecting our theories of heredity and evolution.

Let us first seek to define more clearly the meaning of our terms. The embryologists of the pre-Darwinian period, unhampered by historical conundrums, fixed their attention on the single objective problem of the nature of the germ and its mode of development. The hen's egg contains something which, though not visibly a bird or even an embryo, will when maintained at a temperature of about 37° C. for 21 days cause a living chick to step forth from the shell. What is that something and what manner of machinery (if machinery it be) is set in motion to work such a marvel? The early embryologists found no real answer to this question. They determined the fact that at the beginning the egg contains nothing even remotely resembling a bird; that as early as the second day a rudely fashioned embryo is visible in the egg; and that day by day, as the incubation proceeds, this embryo becomes more complex. The bird appears to be progressively created out of something that is without form and void of visible structure. Its development, said Harvey and Wolff, is essentially a process of 'epigenesis'—a successive formation and addition of new parts not previously existent as such in the egg. This conclusion, roughly outlined by Aristotle, was apparently established on an irrefragable basis of observation,. long afterwards, by Harvey and Wolff. In its superficial aspects the doctrine of epigenesis is no more than a statement of universally admitted fact. When followed to its logical end, however, this conception has failed, and will always continue to fail, to satisfy the mind; and some of the most acute of modern embryologists have expressed the opinion that no thoroughgoing hypothesis of epigenesis can be so framed as to be logical, or even conceivable. Even in the eighteenth century this doctrine was met by the opposing one of preformation and evolution. Advocated by such men as Malpighi, Haller and Leibnitz, this conception underwent its fullest development in the hands of the eminent Swiss naturalist Bonnet. Developed with great logical acuteness and set forth with captivating literary skill, Bonnet's theory was based on the fundamental assumption that the embryo, though invisible, really exists preformed in the egg before development begins. The preformed germ was not conceived to be an exact miniature model of the adult. On the contrary, Bonnet thought of the germ of the fowl, for example, as differing widely in form and proportions from an actual bird, still the original preformation was assumed to be composed of parts that correspond, each for each, to the parts of the chick. Development, accordingly, was conceived to be only the unfolding and transformation of a preexisting structure, not the successive formation of new parts—a process of 'evolution,' not of epigenesis. In this particular form the doctrine of preformation was conclusively overthrown by Wolff; but the principle underlying it has repeatedly and persistently reappeared in later speculations on development, and still contests the field of discussion with its early antagonist.

Hand in hand with this controversy has gone one of still more general scope between the two opposing conceptions that I have referred to as mechanism and vitalism. Is development at bottom a mechanical process? Is the egg a kind of complex machine, wound up like a piece of clockwork, and does development go forward like the action of an automaton, an inevitable consequence of its mode of construction? Or, on the other hand, does development involve the operation of specific vital entelechies or powers that are without analogue in the automaton and are not inherent in any primary material configuration of the egg? This question, I hardly need say, is included in the larger one, whether the vital processes as a whole are or are not capable of mechanical explanation. As a problem of embryology it is very closely connected with that of preformation or epigenesis, and in point of fact the two have always been closely associated. Evidently, by its very form of statement, any theory of preformation or prelocalization in the germ assumes at least a mechanical basis for development, *i. e.*, a primary material configuration upon which the form of development in some measure depends. With theories of epigenesis the case is not so clear; for such theories may or may not be mechanical. Without further preamble I now ask your attention to certain facts which will place clearly before us the form in which these time-honored problems appear to us to-day.

It is a familiar fact that development begins with the progressive segmentation or division of the egg into cells, which, continually increasing in number, finally build up the body of the embryo. Until comparatively recently it was not suspected that the cells thus formed in the earliest stages had any constant and definite relation to the parts of the future body. The fact has now been established, however, instance, the first cleavage-furrow passes pretty accurately through the future median plane of the body, and the two cells thus formed give rise respectively to the right and left sides of the embryo. In a

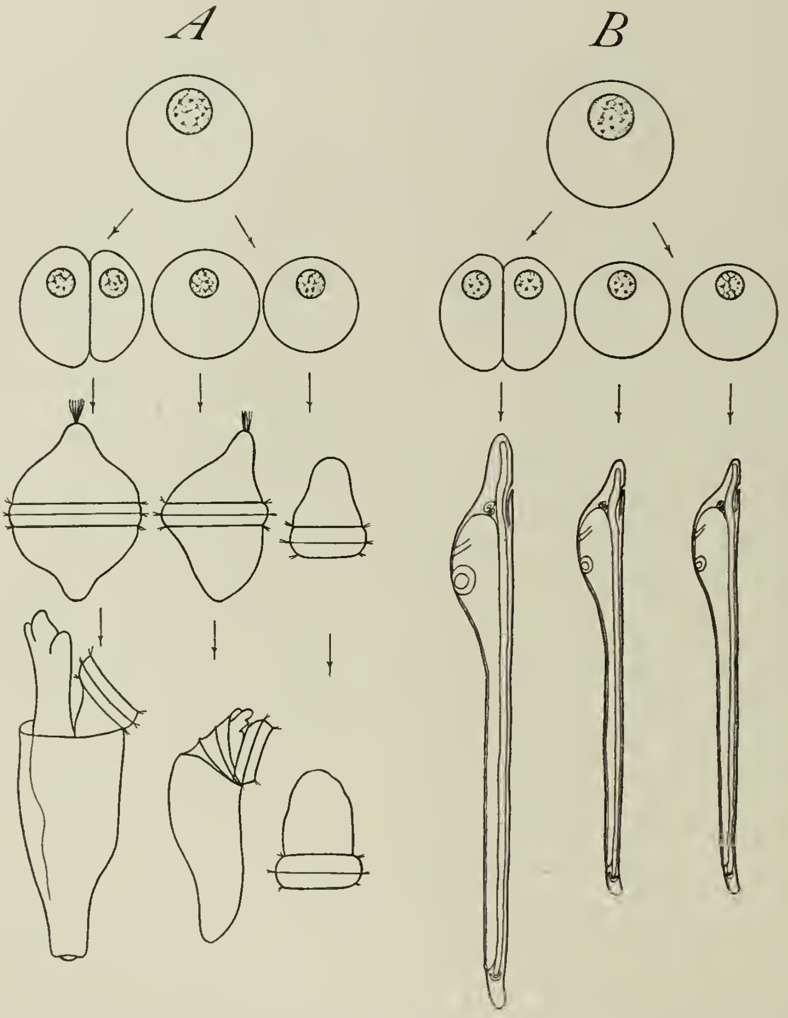

Fig. 1.—Development of entire eggs and of isolated blastomeres of two-cell stage. *A*, *Dentalium;* at the left, development of the whole egg; at the right, development of the isolated first two cells, producing two defective larvæ. *B*, *Amphioxus;* the corresponding experiment, isolated cells producing two perfect dwarfs.

that in a large number of forms (though apparently not in all) such a definite relation exists, both the form of division and the prospective values of the cells being constant. In the egg of the ascidian, for snail's egg the relation is a different one, but is no less definite and constant; in the four-cell stage, for instance, the material that will produce the shell and foot is located, mainly at least, in one of the four cells. Again, in a worm's egg, after its segmentation into sixteen or more cells, we know very exactly how the materials for the head, the segmented trunk-region, the digestive tract, the muscles and the ganglia, are distributed among these cells. In all such cases the embryo seems comparable to a piece of mosaic-work, each cell apparently having its own inherent particular character, and its own specific rôle to play.

These facts place very conspicuously before us a modern form of the problem of preformation which we may conveniently call the problem of 'germinal *prelocalization*.' Does this mosaic-like character of the early embryo mean that the cells are inherently different? Are they in any degree individually predestined for their future development; and if such be the case, can this predestination be traced back to protoplasmic regions in the egg before it has divided into cells? In other words, does the egg, or does it not, contain prelocalized, predetermined areas that have any necessary or causal relation to the parts of the future embryo? This is the first guise in which the old question of preformation presents itself to us to-day. I ask you to glance at the results of a few very simple experiments designed to test this question. They will give apparently quite contradictory results.

Experiments on the eggs of certain animals, such as ctenophores or mollusks, seem to give an unequivocal answer to our questions. If, for example, the cells of the segmenting egg of the mollusk *Dentalium* or *Patella* be separated from one another, at the two-cell stage or any later period, they continue to develop and produce living, actively swimming structures; but these creatures are not completely formed whole embryos, but monsters that in many respects resemble pieces of a single embryo (Fig. 1, *A*). It is true that the wounds usually close and heal; but these structures, nevertheless, remain monstrous and defective, and if they are carefully studied it is found that only when taken collectively can they be said to constitute a single whole embryo. The cells are thus proved to be in some measure inherently different, and to this extent the cell-mosaic is shown to be a real mosaic. If we now extend our operation to the undivided egg, a result in harmony with this is reached. If certain portions of the egg of *Dentalium* be artificially cut off, the remaining portion, upon fertilization, regularly gives rise to a defective and monstrous creature that is not a whole embryo, but resembles a piece or fragment of an embryo. It is evident that this experiment seems to show pretty clearly that even before the egg has begun to divide into cells the parts of the future embryo are in some measure definitely prelocalized and predetermined in its different protoplasmic regions; and evidently, if this be the case, we seem further to have good ground for the mechanistic assumption that the undivided egg contains some kind of structural or material configuration upon which the character of the development depends.

But let us not on this account too hastily accept a theory of preformation or prelocalization. Let us first look at the results of an exactly similar experiment performed on the egg of certain other species of animals, for example, *Amphioxus*, a sea-urchin, or a nemertine worm. Separate here the first two or four cells, and each develops, not into an abortive monster, but into a perfectly formed though dwarf larva (Fig. 1, *B*). Thus it is possible to produce from a single egg from one to four perfect animals; and in case of certain species (hydromedusæ) it is theoretically possible by a similar method to produce from a single egg as many as eight or even sixteen perfect dwarfs. Again, in some of these cases, for instance in the nemertine, the undivided egg may be cut to pieces in any planes taken at random; yet every piece, if of sufficient size, may upon fertilization develop as if it were a whole egg and produce a perfect dwarf. Here is an astounding contrast to the results of our first experiment. What becomes of our theories of prelocalization here, and what becomes of our mechanical theory of development, if we hold such a theory? Neither the cells nor the regions of the egg seem to have any predestination such as is shown in the molluscan egg. It is the essence of a machine or automaton that its operation is due to its structural configuration. Impair or destroy that configuration and the action ceases. But from these eggs we may take away any of the parts, or the

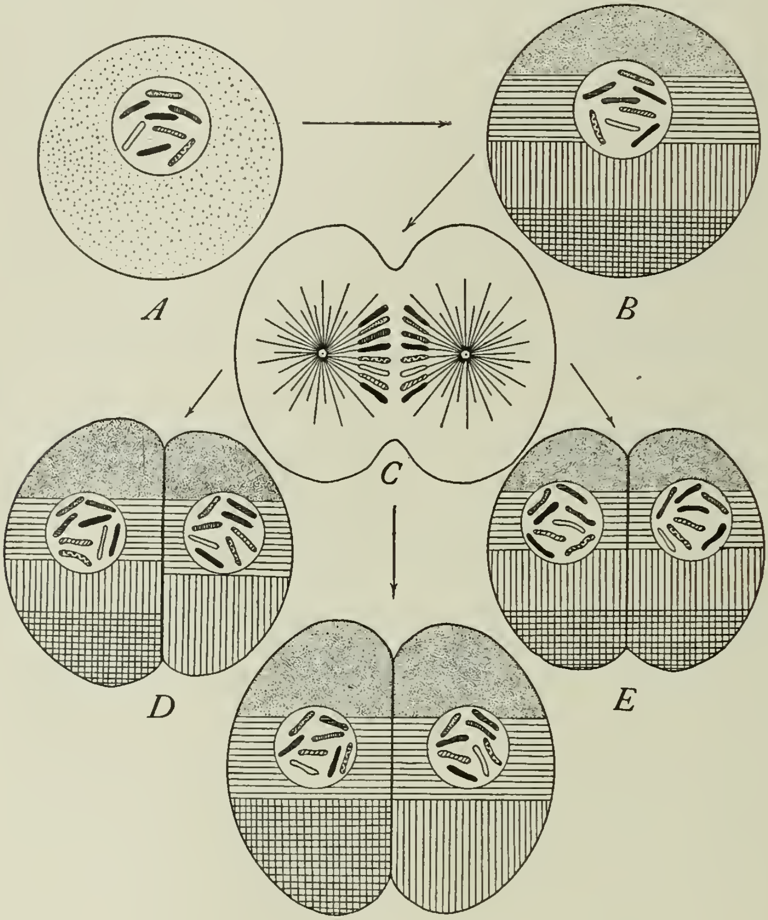

Fig. 2.—Diagram of protoplasmic zones and their distribution at the first cleavage in different forms. *A*, immature egg, assumed to have no definite segregation of protoplasmic stuffs. *B*, mature egg, with protoplasmic zones of horizontal stratification. *C*, first cleavage, division of the chromosomes. *D*, *E*, *F*, different types of two-cell stage. *D*, Dentalium type, the lower zone isolated in one cell. *E*, *Amphioxus*, nemertine, or echinoderm type; equal division of the zones. *F*, hypothetical type with complete separation of two zones at the first cleavage.

whole may be cut to pieces, yet there is no impairment of action, but only a readjustment to form smaller systems like the original whole. The egg, therefore, says the vitalist, can not be an automaton and its development is inexplicable upon a mechanical theory.

Such is the paradoxical result to which a superficial comparison of these two cases leads us—a kind of embryological antinomy, as it were, which at first sight may seem to take away all hope of finding law or order in these phenomena. I will undertake to show you speedily that the apparent contradiction is easily explicable. I have placed the two cases side by side because each seems to demonstrate the truth of one side of an ancient embryological controversy; and we shall presently find reason for the conclusion that each of the opponents, like the two knights and the shield, have recognized but a part of the truth.

The probable explanation of the difference of the behavior between the eggs of *Dentalium* and of *Amphioxus* is a very simple one. When we closely study eggs of this type we find that they do not consist of homogeneous protoplasm, but of different kinds of protoplasmic materials or stuffs that are at the outset arranged, roughly speaking, in horizontal bands or strata, as indicated in the diagram (Fig. 2, *B*), where the number of strata is arbitrarily assumed to be four. Now, an examination of the manner in which the egg divides gives strong reason for the conclusion that in such forms as *Amphioxus* the first division bisects these stuffs, so that each of the first two cells receives one half of each stratum (Fig. 2, *C*, *E*). In the egg of *Dentalium,* on the other hand, this is demonstrably not the case, for the lower stratum passes over bodily into one of the cells and is quite excluded from the other (Fig. 2, *D*). The symmetrical division in *Amphioxus,* the sea-urchin, or the nemertine, gives the immediate possibility of producing two smaller systems similar to each other and to the whole egg. The symmetrical or qualitative division in *Dentalium,* on the other hand, does not give such an immediate possibility, for it produces two different systems neither of which is identical with that of the entire egg. It is highly probable that we find here a proximate explanation of the fact that each of the two cells in *Amphioxus* may produce a perfect dwarf, while in *Dentalium* neither produces such a larva. Facts like these are leading us to the conclusion that the immediate determining causes of development are to be sought in specific protoplasmic stuffs, or organ-forming materials, that are distributed to the cells in a definite way during division. These materials, definitely arranged, are sometimes plainly visible in the undivided egg. I have, for instance, been able to show that the egg of *Dentalium* contains an area of protoplasm at the lower pole that has a causal connection with the formation of the foot and shell, and probably also of the principal part of the mesoblast structures; for if this area be cut off from the unsegmented egg the resulting embryo regularly lacks these structures. In like manner, Professor Conklin has recently been able to recognize in the protoplasm of the unsegmented egg of a species of ascidian the material of the future tail-muscles of the larva; and though no necessary connection between this material and the muscles has thus far been experimentally proved, my experiments on *Dentalium* leave by analogy little doubt that such a causal connection exists. We do not in the least know how these protoplasmic stuffs or materials act. We can hardly imagine how it is that one kind of stuff involves the development of muscles, others that of nerves, ciliated cells, or shell-secreting cells. We may guess that these stuffs may be analogous to the so-called internal secretions, formed in the adult organism by such organs as the thyroid or the sexual glands, which are known to produce quite specific morphological effects on the body. A second guess is that the formative stuffs may be related to the soluble ferments or enzymes, which in other ways play so great a rôle in the economy of plants and animals.

But, aside from this question, the evidence is steadily increasing, I think, that such stuffs exist, that they have a definite arrangement in the egg, and that in cases where the form of cleavage is constant they are distributed in a definite way to the cells into which the egg splits up. The cleavage-mosaic is accordingly to be conceived as an actual mosaic of different materials that are somehow causally connected with the development of particular parts. When these materials are equally distributed by the earlier divisions, as in *Amphioxus,* each of the resulting cells may upon isolation produce a perfect larva; when they are unequally distributed, as in *Dentalium,* the cells are no longer equivalent, and upon being isolated produce the structures corresponding to the particular stuffs allotted to them.* These facts will presently bring us to our first general conclusion. First, if the protoplasm contain such stuffs, grouped and distributed in a definite way, to just this extent may development receive a mechanical interpretation—that is, be conceived as the result of an antecedent material configuration in the egg-protoplasm. We have as yet no very distinct idea regarding the degree of complexity of this initial protoplasmic configuration, though there are facts that indicate that it may not be very great, *i. e.,* that the prelocalization is of a somewhat general character. This question appears, however, to be of relatively minor importance in view of an additional conclusion given by detailed studies on the formation, maturation and early development of the egg. These studies leave no doubt that the grouping of materials observed at the time the egg begins its process of division is not, in some cases at least, a primary or original one, but is of secondary origin. They indicate further that early in the development the egg contains only a few of these specific stuffs, at the very beginning possibly none, and that as development goes forward new stuffs are progressively formed and distributed. Now, if this conclusion is well founded, the actual progressive development of the protoplasm must be conceived as a process of *epigenesis,* not of preformation and evolution. This is the first general result that I desire to emphasize; and it is in harmony with the fact, on which all embryologists have been agreed, since the time of Wolff, that in its obvous features development is by the formation and addition of new parts not previously existent as such in the egg. The embryo is not actually preformed or even predelineated in the protoplasm from the beginning. The protoplasmic stuffs appear to be only the immediate means or efficient causes of differentiation: and we have still to seek its primary determination in causes that lie more deeply. We are thus led to a brief consideration of the question of the physical basis of heredity, which will direct our attention to an element that has hitherto been disregarded, namely, the nucleus, and bring us to a second general result.

* It will appear in the sequel that even in the latter case the potentiality of producing a complete embryo may still be present in the nucleus. It is important to distinguish between such primary or original nuclear potentiality, which may be common to all the cells, and the secondary or immediate potentiality determined by protoplasmic specification. The relation between these is still an unsolved problem.

It was long since suggested by Nägeli

that there is a particular substance or 'idioplasm' peculiar to each species of plant or animal that is transmitted in the germ-cells and has the power to determine the development of the egg according to its nature. Later research has given very strong reason to accept this view in principle, and for the further conclusion that this physical basis is represented by a substance contained within the nucleus and known to cytologists as 'chromatin.' Passing over the cogent, and I believe steadily accumulating, evidence on which this conclusion rests, let us ask how the idioplasm is to be conceived. Some of those who have accepted the general conception of the idioplasm have endeavored to think of it as a very complex but still single and homogeneous substance—the frog's egg, for example, might be conceived as containing a frog-determining substance, the human germ a man-determining substance, and so on. The most recent researches are, however, continually strengthening the ground for a quite different conception, indicating that the chromatin does not operate as a simple substance, but is built into a complex fabric having a definite architecture. We are not here concerned with the particular form of this conception developed by Weismann in his well-known work on the *Germ-plasm,* and elsewhere. I am referring to more recent results of observation and experiment which are giving new and more concrete evidence that the nucleus possesses a complex organization, and apparently one that must be conceived as a kind of primary or original preformation, which bears a certain analogy to that assumed by Bonnet, though quite distinct from it.

We may perhaps most readily approach the grounds for this conclusion by considering, first, an example of the indirect evidence drawn from recent experiments on inheritance. I give a single example, typical of a large number of known cases, of the heredity of single or unit characters in the so-called Mendelian inheritance. If pure gray mice be crossed with pure white albino forms, the hybrid offspring are all gray without visible trace of white. But if these gray hybrids be now paired with each other, both parents being gray, approximately 25 per cent. of their progeny are pure white without a trace of gray, and they continue to produce pure white offspring thereafter. Many similar cases are known, the same proportion of approximately 25 per cent. of the 'recessive' character in the third generation holding true, sometimes with great precision. What does this prove? First, that the white character is not really absent in the gray hybrids but only masked or concealed—'recessive,' in Mendel's terminology; secondly, that the latent white character may in the following generation be completely disentangled or extracted from the gray; thirdly, since the proportion is definite, that the extraction takes place by means of some definite mechanism. We are at present, I think, unable to imagine an explanation of these truly astonishing facts save by the assumption that the gray and white characters are borne in the egg by corresponding discrete bodies or entities of some kind, that may be mixed and unmixed without fusion, shuffled and unshuffled like cards in a pack. The evidence is so far wholly indirect, though I think none the less cogent. But now, bearing in mind that the case of the gray and white mice is but a single example of a widespread phenomenon, let us ask whether we can actually find any definite structures in the egg, and particularly in the nucleus, that may be assumed to represent such entities. One of the most significant and remarkable discoveries of modern biology is the fact that such entities exist, though it is important not to forget that their significance in heredity is

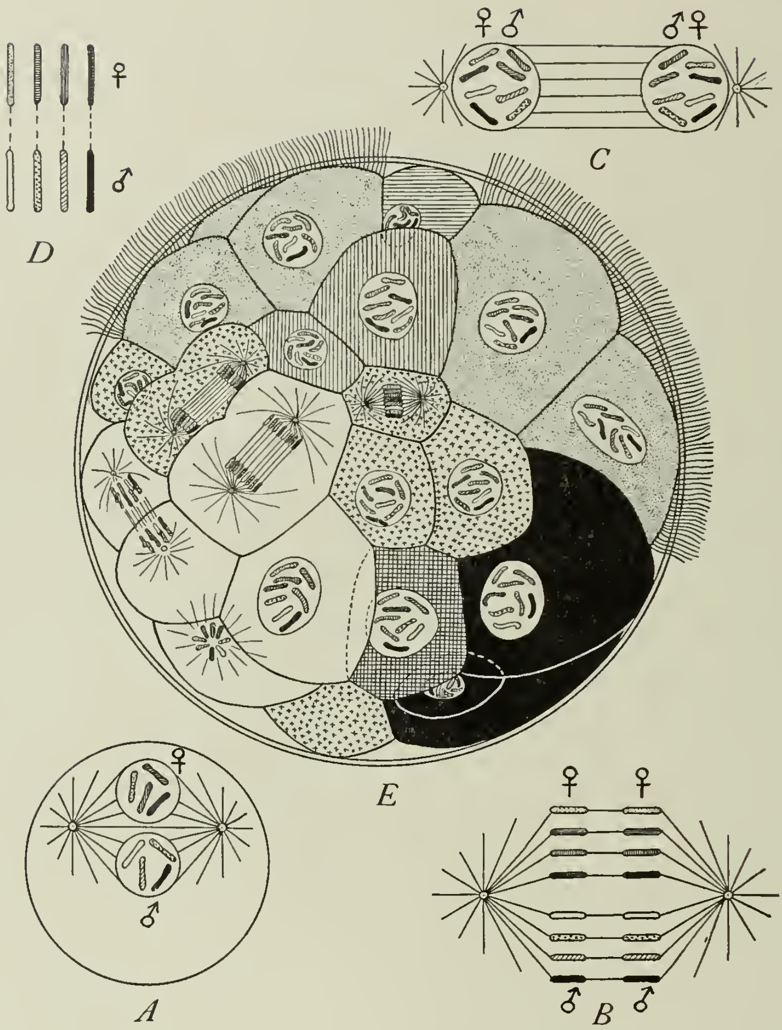

Fig. 3.—Relations of the chromosomes; formation and distribution of protoplasmic stuffs in later stages. *A*, union of the germ nuclei (each assumed to have four chromosomes). *B*, *C*, division of the chromosomes, with equal distribution of the paternal (♂) and maternal (♀) products. *D*, scheme of nucleus at any later stage, with four paternal and four maternal chromosomes (corresponding or homologous chromosomes connected by dotted lines). *E*, actual outline (after Mead) of egg of *Amphitrite* consisting of upwards of 64 cells (nuclei schematized). Entoblast-cells unshaded, primary mesoblast cross-hatched, trochoblasts (ciliated cells) dotted, cells of ventral plate (ventral nervous system, etc.) black; the other cells belong to the ectoblast.

as yet only an assumption, not a completely demonstrated fact.

These entities are bodies known as 'chromosomes,' and are represented in the diagrams by the rods in the nuclei.* I can not within the limits of this address attempt to do more than touch on a few of the discoveries of recent years regarding the chromosomes, though I think they may

* In point of fact the chromosomes are, as a rule, only distinctly visible at the period of cell-division. In the diagram they are represented quite schematically, as if visible in the resting nuclei.

fairly be claimed to constitute one of the most brilliant chapters in the whole history of biology. The number of the chromosomes is constant in each species and, with only a few exceptions of such a kind as to emphasize the rule, the number in sexually produced organisms is always an even one. It has been proved that during the fertilization of the egg one half of the chromosomes are derived from the father and one half from the mother (Fig. 3, *A*), and the still more suggestive fact has been established—with probability through the study of normal development, with almost complete demonstration through the study of hybrids—that at every division of the egg the chromosomes also divide (Figs. 2, *C*, 3, *B*, *C*) in such a manner that their progeny are distributed in equal number, step by step, to all the cells of the body. The remarkable conclusion is thus reached that the fertilized egg, and all the cells derived from it, contain a double set of chromosomes, paternal and maternal (Fig. 3, *D*). The no less interesting result has been experimentally reached that either set—paternal or maternal—is sufficient for complete development (at least as far as the larval stages); for the egg may be caused to develop without the paternal chromosomes, while conversely the paternal chromosomes alone will suffice for the development of an egg from which the maternal nucleus has been removed. Here for the first time we catch a glimpse of the probable physical explanation of the phenomena of dominance and recession that have of late so greatly aroused the interest of experimenters on inheritance; but above all, here is found our first definite basis of observation for the assumption that the nuclear organization is not merely a chemical or molecular one, but represents beyond this some kind of definite material configuration of the nuclear substance.

The time will not allow me to do more than touch on the very recent work that has confirmed and extended this conclusion. It has been found, first, that in some species the chromosomes show constant differences of shape and size, which points towards the conclusion that they may possess specific individual characters. But beyond this indirect evidence, and quite independently of it, Boveri has shown by direct experiments of great ingenuity and beauty that qualitative physiological differences among the chromosomes actually exist; for complete development is only possible in the presence of a particular combination of chromosomes. Hence the conclusion becomes probable that there is a definite causal relation of some kind between the individual chromosomes and the development of corresponding characters or groups of characters; or, in other words, that the hereditary characters are in some manner distributed among the chromosomes which form their physical basis in the egg. We do not yet know in precisely what form this conclusion should be formulated. We do not know, for instance, whether a single unit-character, such as color, is determined by a single chromosome, or by a combination of chromosomes, or whether this may vary in different cases. In this direction we have taken but the first uncertain steps towards a new horizon of discovery. But the point I wish to emphasize is that if we admit such a distribution of characters among the chromosomes in any measure and in any form, to just this extent have we admitted the principle of preformation as applied to the nuclear substance or idioplasm. To this extent do we admit, for example, that the physical basis of inheritance in a frog's egg is not simply a frog-determining *substance*, but is, in close analogy with Bonnet's conception, a kind of original preformation or microcosm, in which the individual frog-characters are in some unknown manner represented by corresponding chromosome-characters. We can hardly imagine at present how this is possible; and it must be freely admitted that such a conclusion has an appearance of artificiality and crudeness that almost inevitably creates a certain feeling of scepticism. Nevertheless, to a conclusion similar in principle to this the facts seem to be pretty definitely pointing.

And now, finally, let us see how this conception, if accepted, is to be united with that of specific protoplasmic stuffs, as already outlined. We do not know in any positive way, but we may roughly present the facts to our minds by a kind of artificial hypothesis—somewhat as Ehrlich and his followers endeavor to present the side-chain theory of immunity by means of rough and crude diagrams. Let us assume, for example, that the specific protoplasmic stuffs are formed one after another by means of substances like enzymes that emanate from corresponding chromosomes.* Putting the matter in the sharpest and crudest way, let us assume that each of the chromosomes in our diagram is responsible for the formation of the stuff correspondingly shaded. A few of these stuffs, formed and distributed as the egg ripens, determine the initial stages of development. In later stages other stuffs are formed by other chromosomes and progressively distributed to the cells by division. Thus the cleavage-mosaic grows progressively more complex and definite as development advances. Each nucleus still contains the germ or potentiality of the whole organism, but the cells assume specific characters according to the protoplasmic stuffs allotted to them (Fig. 3, *E*).

This attempt to portray briefly the *modus operandi* of development is doubtless an excessively naïve mode of formulating a highly complex and subtle process, concerning the real nature of which we still know very little. Even if literally correct it would still leave quite out of account some of the most important elements of our problem. I do not offer it as a well-established or fully rounded conclusion, but rather as a convenient way of placing before you one fundamental result, towards which I believe the drift of recent research is tending. This is that the germ consists of two elements, one of which undergoes a development that is essentially epigenetic, while the other represents an original controlling and determining element. The first is represented by the protoplasm of the egg. The second is the nucleus, which, as I have attempted to show, must apparently be conceived as a kind of microcosm or original preformation, consisting of elements which correspond, each for each, to particular parts or characters of the future organism. The actual development of the embryo, which is manifested by progressive changes in the protoplasm, is by epigenesis, as Harvey and Wolff maintained. Its primary determination is by means of a preformed apparatus, handed on to the egg from preceding generations in the nucleus, which, though not in any sense a miniature model of the adult, yet somehow embodies in infinitesimal compass, the heritage of the race. And thus the most recent discoveries in this difficult field of research are bringing us to a position which can hardly be better stated than in the words written by Huxley more than thirty years ago: "The process which in its superficial aspect is epigenesis appears in essence to be evolution, * * * and development is merely the expansion of a potential organism or original preformation according to fixed laws." We should not, with the advantage of our present standpoint, read into these words of Huxley's a meaning which it was impossible

* *Cf.* Driesch's 'Ferment-Fiktion,' Analyt. Theorie, pp. 87–92.

that he should have had in mind in writing them; yet without yielding to this temptation we may fairly pay our humble tribute of admiration and homage to a scientific insight that was capable of reaching such a conclusion in the far away prehistoric period when chromosomes and Mendelism were unsuspected, when the nature of fertilization was unknown, and the internal mechanism of development was a wholly unsolved riddle.

I will in conclusion add only a few words on the question of vitalism and mechanism in the light of the foregoing results. In so far as development may be conceived as the outcome of an original material configuration in the nucleus, and a secondary configuration in the protoplasm, it may be conceived as a mechanical process. But it must be admitted that this conception leaves quite unsolved certain fundamental elements of our problem—such, for instance, as the manner and order in which the protoplasmic stuffs are formed and assume their characteristic configuration, whether in the whole egg or in the isolated blastomere or egg-fragment; or again, how the wonderful phenomena of the regeneration of lost parts in the adult organism can be explained. We have at present no positive data for an answer to these questions. But it can hardly be disputed that we have already made a considerable advance towards a mechanical solution of the problem, and if this be so, by what right does the vitalist demand that we shall adopt his hypothesis for the portions still unsolved? Let us seek an answer to this question in the answer to a broader one. What is the object of the study of development? I should state this object somewhat as follows: First, to observe and to describe as completely and simply as possible the actual phenomena of development; secondly, to determine to what extent, from its beginning in the egg to its completion in the adult organism, the process can be formulated in terms of the elementary laws of matter and of motion. But this is only a different way of stating that our object is to ascertain in what measure the operations of development, under given external conditions, are the result of an original configuration of material particles in the egg. Now, I do not need to say that even the approximate accomplishment of these aims is still very remote, their complete accomplishment impossible. I am fully in accord with the neo-vitalists in their assertion that the phenomena of development and of life generally have not yet been reduced to a mechanical basis, that they can not at present be fully described in physico-chemical terms. It is certain that living beings exhibit structures more complex than any existing in the inorganic world, and different from them in kind. It is possible, probable I believe, that living bodies may be the arena of specific energies that exist nowhere else in nature. I admit fully that the interpretation of development I have endeavored to outline does not exclude, but in some ways actually suggests, the existence of such energies. I should, therefore, even admit that the vitalists are wholly right in their contention that the vital processes are not at present explicable as the direct result of such energies as are observed in the non-living world. To prejudge this question would set up a dogmatic barrier to progress, not only in biology, but also in chemistry and physics. If this be vitalism there are probably many of us who must be enrolled as 'vitalists,' however doubtfully we may regard the honor of bearing such a title. But if the word 'vitalism' be used in any other sense than as a convenient phrase, an x by which to designate an unknown quantity, if it be taken in a positive sense to imply in the living organism any negation of the fundamental laws of matter and of motion, the existence of any distinctive entity, or principle that does not fall within the chain of physical causation or that contravenes the general laws of physics, then, I protest, to accept 'vitalism' as a principle of interpretation is deliberately to abandon the scientific method in biological study.

Edmund B. Wilson.

THE AMERICAN PALEONTOLOGICAL SOCIETY. SECTION A—VERTEBRATA.

Section A of the American Paleontological Society held its third annual meeting in common with the other societies on December 27, 28 and 29, and greatly enjoyed the admirable arrangements made by the officers of the University of Pennsylvania, especially by Professor Conklin. The President, Professor Henry F. Osborn, presided. At the close of the meeting Professor W. B. Scott was elected president and Dr. Marcus S. Farr secretary, both of Princeton University.

The meeting included a series of eighteen papers presented in person or in manuscript by Messrs. Osborn, Eastman, Sinclair, Case, Lull, Patten, Brown, Gidley, Hay, Loomis, Farr, Scott, Petersen, Douglass, Williston, Matthew and Granger. These were presented on Tuesday afternoon and on Wednesday and Thursday mornings. On Wednesday forenoon the president delivered his annual address, entitled 'Ten Years' Progress in Mammalian Paleontology.' In this address, which will be printed in full elsewhere, the history of the science during the last decade was followed in detail, and the principal advances, in the discovery of new forms, principles, and methods of work, were outlined. On Thursday morning the principal feature was the discussion of the phylogeny and classification of the Reptilia, in which Messrs. Osborn, Williston, McGregor and Hay participated. In this discussion Professor Osborn opened with a general review, pointing out the gradual development of the idea of a double grouping of the reptiles, beginning with Baur's phylogeny published in 1889 and continued in the phylogenies and discussions of Cope, Smith Woodward, Broom, Nopcsa, Williston, Boulenger, Osborn and McGregor. The following table is that of Osborn, 1904.

The chief differences of opinion at present relate to the position of the Ichthyosauria, Sauropterygia and Testudinata, some authors placing the Ichthyosauria as intermediate between the two groups, others placing them frankly with the descendants of the rhynchocephaloid reptiles, as suggested by Baur. Boulenger derives both the Sauropterygia and the Testudinata from the rhynchocephaloid, or diapsidan, group; whereas all other authors take them off from the synapsidan group.

Professor Williston continued the discussion, speaking especially of the Sauropterygia. He first stated that he considered the Sauropterygia and Testudinata as fundamentally separate groups, all their points of likeness being due to analogous evolution, while their points of difference are fundamentally distinctive. He considered the Triassic plesiosaurs Nothosaurus and Lariosaurus, as not ancestral to the Jurassic and Cretaceous plesiosaurs, but as representing an independent offshoot. He maintained that the Proganosauria, represented by the Permian genera *Mesosaurus* and *Stereosternum*, were certainly not ancestral to the plesiosaurs, as held by Seeley and Boulenger. The Testudinata are also widely separated from the Placodontia, and are probably of direct Cotylosaurian origin. The points of convergence are partly correlated with the large size of the paddles of plesiosaurs and turtles, the short tail being correlated with the long propodials in the plesiosaurs, whereas in the

Subclass **SYNAPSIDA** Osborn 1903. Order **Cotylosauria** Cope 1880 (Pareiasauria Seeley 1889).
Superorder ANOMODONTIA Owen 1860. (Theromorpha Cope 1878, in part.)
Order **Theriodontia** Owen 1876. Suborder Therocephalia Broom 1903.
Suborder Cynodontia Owen 1861.
Order **Dicynodontia** Owen 1860.
Order **Placodontia** *auct. ex* H. von Meyer 1863 Incertæ Sedis.
Order **Sauropterygia** Owen 1860. Suborder Simosauria *auct. ex* Gervais 1845. (Nothosauria Seeley 1882.)
Suborder Plesiosauria *auct. ex* Quenstedt 1852.
Order **Testudinata** *auct. ex* Shaw 1802.
Suborder Pleurodira *auct. ex* Duméril and Bibron 1835.
Suborder Cryptodira *auct. ex* Duméril and Bibron 1835.
Suborder Trionychia *auct. ex* Pictet 1853.

Subclass **DIAPSIDA** Osborn 1903.
Superorder DIAPTOSAURIA Osborn 1903.
Order **Procolophonia** Seeley 1867.
Order **Protorosauria** Seeley 1887.
Order **Proganosauria** Baur 1887.
Order **Gnathodontia** Owen 1680. (Rhynchosauria Osborn 1903).
Order **Pelycosauria** Cope 1878.
Order **Choristodera** Cope 1877.
Order **Rhynchocephalia** Günther 1868.
Order **Parasuchia** Huxley 1875.
Suborder Aëtosauria Nicholson and Lydekker 1889.
Suborder Phytosauria Baur 1894 *ex* Jaeger 1828.
Order **Ichthyosauria** Blainville 1835 *ex* Jaeger 1824. (Ichthyopterygia Owen 1860.)
Order **Crocodilia** Wagler (?) 1830.
Suborder Mesosuchia Huxley 1875.
Suborder Eusuchia Huxley 1875.
Suborder Thalattosuchia Fraas 1901.
Superorder DINOSAURIA Owen 1840.
Order **Theropoda** Marsh 1881.
Suborder Megalosauria *ex* Fitzinger 1843. (Thecodontia Owen 1860.)
Suborder Symphypoda Cope 1867. (Compsognatha Huxley 1870.)
Order **Opisthocœlia** Owen 1860. (Sauropoda Marsh 1881.)
Order **Orthopoda** Cope 1866. (Predentata Marsh 1894.)
Superorder SQUAMATA Oppel 1811.
Order **Lacertilia** Owen 1839.
Order **Mosasauria** *auct. ex* Gervais 1845.
Order **Ophidia** Brogniart 1802.
Order **Pterosauria** *auct. ex* Kaup 1834.

ichthyosaurs the long tail is correlated with short propodials. In both plesiosaurs and turtles the ilium is directed downward and forward, in correlation with the backward thrust of the paddles; in both, the scapula acquires secondarily a proscapular process. The fundamental characters distinguishing the two groups may be summarized in the table given below.

Continuing the discussion, Dr. J. H. McGregor maintained and expanded his previous argument for the derivation of the Ichthyosauria from the Diapsida, and for the probably secondary nature of the closed condition of the temporal arch region of the skull.

Turtles.	Plesiosaurs.
Vomer (parasphenoid) unpaired.	Paired prevomers.
No posterior parasphenoid process.	A separate parasphenoid.
Opisthotic separate	Opisthotic not separate.
Cervicals eight.	Cervicals 13–76.
Ribs intercentral in attachment.	Ribs diapophysial in attachment.
Ten dorsals.	Twenty dorsals.

Dr. O. P. Hay pointed out the now convincing evidence that the original Testudinata had a closed, or solid, temporal roof to the skull, as seen in the primitive Amphychelydia, and persisting in the Cheloniidæ; in other words, the production of an open temporal roof is secondary, in the more primitive families it is less reduced, in the lowest families it is still closed. From this original condition reduction has taken place in most forms from behind; in others, as some pleurodires, from below. There is thus no true supratemporal fossa. The parieto-squamosal arch in some pleurodires is proof of the presence originally of a solid roof. The turtles have been derived from the Cotylosauria, possibly through the Chelydosauria. With the Cotylosauria the turtles agree in possessing eight cervical and ten dorsal vertebræ. He pictured the primitive turtle as having a short, broad head, with overroofed temporal region and a short supraoccipital; a short neck consisting of eight vertebræ, with short neural spines, long transverse processes and bicœlous centra; a distinct proscapular process representing a procoracoid; caudal vertebræ with chevrons; a dermal armature consisting of plates of bone overlying the ribs and neural arches, and above this a mosaic of small bones embedded in the skin; a plastron consisting of the clavicles and interclavicle and the lateral elements of a parasternum, outside of which was a dermal armor of small plates. He maintained further that the turtles and the plesiosaurs are so different that they should be placed in different subclasses.

Dr. F. B. Loomis read a paper on 'The Amherst College Expedition to the Wasatch and Wind River Basins in 1904.' A rich collection of Wasatch forms will supplement several of the less known species. One *Eohippus* in which the paraconid is bifid, and a tiny *Anaptomorphus*, only two thirds the size of *A. homunculus*, are among the species. The beds are 2,180 feet thick. In the Wind River basin a new and rich locality was found, six miles above the mouth of Bridger Creek. There were collected at least three species of *Hyopsodus*, four of *Notharctus*, one of *Anaptomorphus*, three of *Paramys*, one of *Oxyæna*, one of *Esthonyx* and two of *Coryphodon*. The latter is represented by teeth and a nearly complete skeleton.

Mr. O. A. Petersen sent a paper entitled 'Suggestions Regarding the Probable Origin of *Dæmonelix*.' It has been regarded as a plant, but the author concludes that it represents the burrow of the extinct rodent *Steneofiber*. In his explorations he found, in the materials filling the burrows, portions of skeletons of the rodent mentioned.

Mr. Earl Douglass presented a paper on 'A New Monotreme-like Mammal from the Lower White River Beds.' The skull was described and drawings of it shown. While presenting numerous resemblances to the monotremes the author expresses some doubts on the relationships.

Professor W. B. Scott, referring to recent work of Roth on the South American Ungulates, held that the ordinal term Notoungulata suggested by Roth should include three grand divisions and subdivisions as follows:

I. Toxodontia.
  - Toxodontia.
  - Homalodontotheria.
  - Typotheria.

II. Astrapotheria.

III. Litopterna.

Among the common characters are the following:

1. The double ankle joint.

2. The pillar on the inner side of the posterior crescent in the lower molars, the homologies of which are at present obscure.

Division I., including the Toxodontia, Typotheria and Homalodontotheria is especially distinguished by (1) swollen auditory region, (2) zygomatic arch ending on the top of the skull. The Astrapotheria stand apart in the enlargement of the canines, showing analogies with the Amynodontidæ, which are, however, deceptive. Like the Litopterna they lack the auditory expansion. All these ungulates are further distinguished by being entirely hornless.

Dr. O. P. Hay read a paper 'On the Group of Fossil Turtles known as the Amphichelydia.' The author's studies are based on a very complete skeleton of the Jurassic *Compsemys plicatula* in the American Museum and several fine specimens of *Baena*, collected in the Bridger beds of Wyoming. In the members of this super-family the temporal region is roofed in, there are nasals and a lachrymal bone; the pterygoids exclude the quadrate from contact with the basisphenoid; the cervical vertebræ may be biconcave or one or both ends may be convex; the neck short and adapted for motion in all planes, but more like that of the Pleurodira; the pelvis not suturally articulated with the shell. The group has evidently given origin to the Cryptodira and the Pleurodira, the former retaining the skull structure, the latter group retaining the neck and shell structures.

Papers were also read by Mr. W. J. Sinclair on 'The Marsupials of the Santa Cruz Formation'; by Dr. Wm. Patten, 'On the Structure of the Ostracoderms'; by Dr. M. S. Farr, 'On Mammals from the Fort Union Beds.'

Professor Wm. Patten described the structure of *Bothriolepis*, based on the study of a large number of well-preserved specimens recently obtained by him in New Brunswick. Many specimens were exhibited which illustrated and confirmed the most important features of the description. The structure of the mouth parts, the position of the gills, anus, anal fin and other organs indicate that the Ostracoderms must be separated from all other known subdivisions of the Chordata and raised to the dignity of a separate class.

Professor S. W. Williston reported on an important new locality for Triassic vertebrates on the east side of the Wind River range, near Lander, Wyo., yielding the most important remains which have yet been found in the American Triassic. The collections, which as yet have not been prepared and studied, represent four great groups, as follows: The Labyrinthodontia are represented by very large forms allied to *Metoposaurus*, of Wurtemberg, but generically distinct from it. The Dicynodontia, or Anomodontia, heretofore not represented in America, are apparently represented in portions of a skeleton, including a humerus resembling that of *Platypodosaurus*, and a pelvis remotely suggesting that of *Tapinocephalus*. The teeth named *Palæoctonus* by Cope and referred to a dinosaur, probably belong to members of this group, the affinities of which still require further study. The third group is widely distinct, including an animal with a slender humerus, a scapulo-coracoid with very prominent glenoid fossa, the blade of the scapula being placed at right angles to the lower portion of the arch, the humerus without entepicondylar foramen; the resemblances are rather with the Pterosauria than any other group. The fourth great group is the Phytosauria; here no less than four skulls of the Belodontia were found, all different, probably representing four genera, differing in the elongation of the snout and position of the nostrils, and adding substantially to our knowledge of this group. The author incidentally remarked that he had positively determined that the *Hallopus* Beds near Cañon City, Colorado, are of Triassic and not Jurassic age; these beds contain labyrinthodonts and crocodiles which belong to a higher horizon than that discovered near Lander.

The author further stated that he placed the Como beds as equivalent to the Wealden, and as representing either the upper or middle part of the Lower Cretaceous.

Dr. E. C. Case read on 'Characters of the Chelydosauria.'

The Permian genus *Diadectes* was shown to be a member of the order Chelydosauria of Cope. This order was founded on the genera *Otocœlus* and *Conodectes* and was considered as ancestral to the turtles.

The discovery that *Diadectes* is a member of this order permits a more complete description of its characters from especially perfect specimens collected by the author of the paper.

The members of the Chelydosauria (Diadectidæ and Otocœlidæ) differ from the Cotylosauria (Pareiasauridæ, Pariotichidæ, Elginidæ(?)) by the following characters; and in the same characters approach the Testudinata.

1. There are three pairs of openings through the roof of the skull instead of two; the extra pair being the openings of the *meatus auditus externus*.

2. The palate is very degenerate and the transverse bone is lost or nearly so.

3. The form of the quadrate and its relations to the surrounding bones are directly comparable to those of the turtles.

4. There are no teeth on the pterygoids and palatines.

5. There is no anterior process (parasphenoid) on the basisphenoid bone and correlated with this.

6. There are no prevomers but a single, anteriorly placed vomer (parasphenoid?).

7. The internal carotid arteries do not penetrate the lower surface of the basisphenoid, as in the *Rhyncocephalia*, but enter from the side as in many turtles.

8. The presence of paired descending plates from the under side of the parietal and the possible absence of the epipterygoid.

9. The presence of dorsal plates overlying the dorsal ribs and the presence of eighteen presacral vertebræ (the last common to Cotylosauria).

There is no trace of a beginning plastron.

It is concluded that the characters of the skull establish the validity of the order Chelydosauria and indicate the direct origin of the turtles from the Cotylosauria.

On Eocene Insectivora and on Pantolestes in particular: W. D. Matthew.

The genus *Pantolestes* Cope, variously referred to the Primates, Creodonta and Artiodactyla, turns out to be a fossorial insectivore of an archaic and peculiar type. A well-preserved skull and jaws and a large part of the skeleton were obtained by the American Museum Expedition in the Bridger Basin last summer. The teeth resemble those of the most primitive creodonts, the skull is most like that of the Centetidæ, and unlike the creodont or condylarth skulls; the limbs and feet are specialized for digging, more than in the badger but less than in the moles; the tail is long and very massive, the postsacral vertebræ being larger than the presacrals. *Palæosinopa* Matthew is the Lower Eocene ancestor of *Pantolestes; Pentacodon* Scott, of the Basal Eocene, appears to be a related genus. The addition of the Pantolestidæ and of some undescribed genera recently discovered, and also, if Wortman's assertion is supported by evidence, of the Hyopsodontidæ, to the list of Eocene Insectivora, greatly increases the importance of that order among the Mammalia of the early Tertiary. The present distribution of the Insectivora indicates that they must once have been an abundant and varied group; but fossil insectivores have hitherto been quite rare and for the most part nearly related to the three common living families, the hedgehogs, moles and shrews.

We now recognize the order as an important group in the Eocene, including a considerable variety of primitive types, and showing relationship on the one hand to the Primates, on the other to the Creodonta. *Trigonolestes* Cope, of the Lower Eocene, is not related to *Pantolestes* but is a true artiodactyl.

Dr. R. S. Lull read a paper on 'Footprint Interpretation' of which this abstract is given. The first dinosaur was found in the Connecticut Valley at New Windsor in 1818; but not until the civil war was a specimen brought to light of sufficient perfection to be considered in footprint interpretation. Even then little was known of the true nature of these forms other than that they were saurians. Marsh's restorations, based upon further material discovered at New Windsor, gave the first opportunity for a correlation of the osseous remains with the footprints. The tracks fall into three classes—truly bipedal forms; those of bipedal gait and quadrupedal resting posture; and finally true quadrupeds.

Of the first group the track genus *Anchisauripus* may be correlated with the family of Dinosauria known as the Anchisauridæ; *Gigandipus* has resemblances to *Allosaurus*, though a somewhat smaller form having a sinuous tail trace; in *Grallator* the feet are very small, with limbs of great proportionate length, representing a group of aberrant compsognathoid dinosaurs probably of habits similar to the wading birds. These genera were all Theropoda, or carnivorous dinosaurs. *Eubrontes* includes truly bipedal forms, large, bluntly clawed, probably of herbivorous habits; hence a predentate dinosaur.

The occasionally quadrupedal creatures were as truly bipedal types as those of the first group while moving, but always brought the hands in contact with the ground while resting. The most important genus is *Anomœpus*, an herbivorous dinosaur whose proportions suggest *Hypsilophodon;* while *Otozoum*, a huge creature with a plantigrade foot, having a shelf-like extension of skin around it presumably to support the great weight of the animal in soft mud, has no counterpart among known dinosaurs; and one can form no conception of its probable appearance. Except for its bipedal gait it presents some interesting points of comparison with *Chirotherium* of the Bunter.

Quite a host of quadrupedal tracks are known which must include both Amphibia and Reptilia, but one genus only, *Batrachopus*, can with any degree of certainty be correlated with known types. *Stegomus longipes*, a small Aëtiosaur from Longmeadow, Mass., seems to show proportions, size and length of limb which would make its relationship with *Batrachopus* fairly assured. In this track genus the stride is extremely long and the trackway narrow, implying a form with high stilted limbs and a gait like a cursorial mammal.

Thus far only can we at present interpret fossil footprints with any degree of assurance.

Dr. C. R. Eastman sent a paper entitled 'Fossil Bird Remains from Armissan.' This paper, which is in course of publication by the Carnegie Museum, discusses the paleontological history of gallinaceous birds, and offers a description of a new species of *Taoperdix*, a form related to existing pheasants, and noteworthy as appearing as early as the Upper Eocene. From the type species it differs chiefly in the relative proportions of mandible and wing-bones. The original is preserved in the Carnegie Museum at Pittsburgh, and has been courteously loaned by Dr. W. J. Holland.

Also a paper on 'Anaximander, Earliest precursor of Darwin.' The doctrine of evolution, far from being a purely modern conception, was anticipated in its essential features by Ionian philosophers of the sixth century B. C. Writers, however, are disagreed as to which of these may properly be considered as the earliest evolutionist. A collation of the extant fragments of Anaximander, with critical interpretation of the same, reveals an acuteness and suggestiveness on the part of their author such as entitle him to high estimation amongst the founders of the main theory.

A paper entitled 'Recent Exploration of a Pleistocene Fissure in Northern Arkansas,' by Mr. Barnum Brown, describes what might be termed a bone mine from which nearly ten thousand identifiable bones were taken.

It is shown that a large number of the animals entombed here have been dragged in by weasels, which are actually found in their lairs in the wall of the fissure. Other carnivorous animals, such as the saber-toothed tigers, probably inhabited this fissure and brought in the remains of deer and hogs.

Thirty-four genera and fifty-five species are recognized. A new genus of skunks, *Brachyprotoma*, is described; also nine new species of different animals.

The fauna is compared with recent and fossil forms and tends to show that the fossil forms are boreal types and that the climate at this latitude was much colder during the Pleistocene period than at present.

Although many of the fossil species can not be separated from living forms, the large number of extinct species places the age of this fauna at some time prior to the middle Pleistocene.

O. P. Hay,
Secretary.

THE ASSOCIATION OF AMERICAN GEOGRAPHERS.

The Association of American Geographers was organized in Philadelphia, December 29, 30, with about fifty members, of whom about twenty-five were present. The following officers were elected:

President—W. M. Davis, Cambridge, Mass.

Vice-Presidents—G. K. Gilbert, Washington; A. Heilprin, Philadelphia.

Secretary and Treasurer—A. P. Brigham, Hamilton, N. Y.

Councillors—R. S. Tarr, Ithaca, N. Y.; Cyrus C. Adams, New York; H. C. Cowles, Chicago.

The object of the association is "The cultivation of scientific geography in all its branches, especially by promoting acquaintance, intercourse and discussion amongst members, by encouraging and aiding geographical exploration and research, by assisting the publication of geographical essays, by developing better conditions for the study of geography in schools, colleges and universities, and by cooperating with other societies in the development of an intelligent interest in geography among the people of North America." No regular publication will for the present be issued by the association, it being the opinion of its members that existing geographical journals afford sufficient opportunity for bringing out their essays. The annual meetings of the association will ordinarily be held in connection with the winter meetings of the American Association; but it is probable that the meeting next year will be held in New York city. A summer field meeting is in consideration.

The desire of the organizers of the association is to bring together the investigating geographers of the country, and to lead those who are working on the organic and inorganic sides of geography on the human, economic, zoological, botanical, climatic, oceanographic and geologic sides of this many-sided subject—to present their results in each other's presence. While full membership is limited to those who have already accomplished some original work, it was suggested that inquiry be made to learn whether others who have specialized less in geography would care to take associate membership. In any case the meetings of the association will be open to all interested persons, and a special welcome will be given to those whose further work would naturally lead them into the association.

The program of the meeting in Philadelphia included the following papers, all of which were presented by the authors, except where stated as read by title.

Bailey Willis: 'Some Physical Aspects of China.'

F. E. Clements: 'The Interaction of Physiography and Plant Successions in the Rocky Mountains.' Read by title.

E. Huntington: 'The Seistan Depression in Eastern Persia.'

L. Stejneger: 'The Distribution of the Discoglossoid Toads, in the Light of Ancient Land Connections.'

A. P. Brigham: 'The Development of the Great Roads across the Appalachians.'

R. W. Pumpelly (by invitation): 'Physiography of the Northern Pamer.'

R. S. Tarr: 'Some Instances of Moderate Glacial Erosion.'

D. W. Johnson: 'The Distribution of Freshwater Faunas as Evidence of Drainage Modifications.'

H. C. Cowles: 'The Relation of Physiographic Ecology to Geography.'

R. A. Daly: 'The General Accordance of Summit Levels in a High Mountain Region: the Fact and its Significance.'

I. Bowman (by invitation): 'Partly Submerged Islands in Lake Erie.' Read by title.

Cyrus C. Adams: 'The Improvement of American Maps.' Read by title.

R. E. Dodge: 'The Journal of Geography and its Purpose." Read by title.

F. E. Matthes: 'The Study of River Flow.'

L. G. Westgate (by invitation): 'The Geographic Features of the Twin Lakes District, Colorado.'

N. H. Darton: 'Geologic Expression in Contour Maps.' Read by title.

H. F. Reid: 'The Forms of Glacier Ends.' Read by title.

F. P. Gulliver: 'Muskeget a Complex Tombolo.' Read by title.

W. Libbey: 'The Physical Characters of the Jordan Valley.' Read by title.

W. M. Davis: 'A Chapter in the Geography of Pennsylvania.' Read by title.

G. K. Gilbert: 'Moulin Sculpture.'

G. W. Littlehales: 'A New and Abridged Method of Finding the Locus of Geographical Position, and Simultaneously therewith the True Bearing.' Read by title.

In addition to the above, Professor W. M. Davis, in assuming the presidency of the association, presented a brief address on 'The Opportunity of the Association of American Geographers'; this paper will be printed in the *Bulletin of the American Geographical Society*. Most of the papers were accompanied by lantern illustrations, and it should be stated that most of the authors were present, whose papers were read by title, the papers being withheld from presentation for lack of time.

Extracts were read from a letter sent by Professor E. de Martonne, announcing that an international association of European geographers would probably be formed next spring. It was voted to send to Professor de Martonne the best wishes of the American Geographers for the formation of the European association.

Following is a list of the original members of the Association of American Geographers: C. Abbe, Jr., Washington; Ch. C. Adams, Ann Arbor; Cy. C. Adams, New York; O. P. Austin, Washington: R. L. Barrett, Chicago; A. P. Brigham, Hamilton, N. Y.; A. H. Brooks, Washington; H. G. Bryant, Philadelphia; M. R. Campbell, Washington; H. C. Cowles, Chicago; J. F. Crowell, Washington; R. A. Daly, Ottawa, Can.; N. H. Darton, Washington; W. M. Davis, Cambridge; R. E. Dodge, New York; C. R. Dryer, Terre Haute; N. M. Fenneman, Madison, Wis.; H. Gannett, Washington; M. K. Genthe, Hartford; G. K. Gilbert, Washington; J. P. Goode, Chicago; H. E. Gregory, New Haven: F. P. Gulliver, Southboro, Mass.; C. W. Hall, Minneapolis; R. A. Harris, Washington; A. Heilprin, Philadelphia; R. T. Hill, Washington; E. Huntington, Milton, Mass.; M. S. W. Jefferson, Ypsilanti; Emory R. Johnson, Philadelphia; Wm. Libbey, Princeton; G. W. Littlehales, Washington; C. F. Marbut, Columbia, Mo.; F. E. Matthes, Washington (Camb.); W J McGee, Washington; R. Pumpelly, Newport, R. I.; H. F. Reid, Baltimore; W. W. Rockhill, Washington; R. D. Salisbury, Chicago; E. C. Semple, Louisville; G. H. Shattuck, Baltimore; L. Stejneger, Washington; R. S. Tarr, Ithaca; R. DeC. Ward, Cambridge; B. Willis, Washington.

Albert Perry Brigham,
Secretary.

SCIENTIFIC BOOKS.

Technical Mechanics. By Edward R. Maurer, professor of mechanics in the University of Wisconsin. New York, John Wiley & Sons. 1903.

Elements of Theoretical Mechanics. By Alexander Ziwet, junior professor of mathematics in the University of Michigan. Revised edition of 'An Elementary Treatise on Theoretical Mechanics,' especially designed for students of engineering. New York, The Macmillan Company. 1904.

Die Technische Mechanik. Elementares Lehrbuch für Mittlere Maschinentechnische Fachschulen und Hilfsbuch für Studierende Höherer Technischer Lehranstalten. Von P. Stephan, Regierungsbaumeister, Lehrer an der Kgl. Höheren Maschinenbauschule in Posen. Erster Teil: Mechanik Starrer Körper. Leipzig und Berlin, B. G. Teubner. 1904.

The teacher of mechanics who undertakes to write a text-book for students of engineering is confronted with a difficult problem. He is compelled to recognize the justice of the demand that the course shall be practical, while resisting the tendency to interpret the practical too narrowly. While a rather extensive course seems to be demanded by the manifold applications of mechanics in engineering, his experience in the class-room emphasizes strongly the limitations imposed by restricted time and lack of maturity of students. It will scarcely be questioned that the matter of first importance to the student is a clear understanding of principles rather than an assortment of special rules for solving particular problems. The presentation of principles in a sound and intelligible manner should, therefore, be the chief aim of a text-book, and methods of presentation and illustrative examples should be chosen primarily with reference to this aim.

The success with which this requirement is met by the three books under review will be differently estimated by different teachers. Each possesses merit of a high order, and there is little room for adverse criticism except such as implies a fair difference of opinion as to what methods of treatment are to be regarded as best. It will here be attempted only to indicate the character and scope of each of the books, and to make some general observations regarding methods of presenting the principles of mechanics in an elementary text-book.

As a sound and practical text-book for the use of students of engineering Professor Maurer's book possesses high merit. The exposition is nearly always concise—indeed, this is perhaps often carried to a fault—but the soundness of the logic is rarely open to question. The author shows close sympathy with the point of view of the beginner, and appreciation of the fact that at certain points the conventional treatment of fundamental principles fails to meet the needs of the ordinary student.

Professor Ziwet's book is an excellent introduction to the science of analytical mechanics. His exposition is in general sound and logical, and the book will be read with pleasure and profit by a student of mathematical tastes and ability who has the requisite mathematical training. The maturity and mathematical equipment required for reading it at all easily appear to be greater than are possessed by most of those who take up the subject in the second or third year of the ordinary four-year course in engineering, but the book will doubtless prove effective in the hands of a teacher who is in sympathy with the methods and point of view of its author.

Stephan's book is admirable for the simplicity with which elementary principles and methods are presented. If written in English it would probably find favor with many teachers in America who desire a text-book not presupposing calculus. It should be said, however, that while calculus notation is not employed by Stephan, he does employ the conceptions of both differential and integral calculus. The fundamental conceptions of the calculus are, of course, necessarily employed in any sound presentation of the principles of mechanics, and it may be doubted whether real simplicity is gained by avoiding its notation.

The three books are all designed for students of engineering, and each aims to be practical by including many numerical exercises and illustrative examples of the kind met in engineering practise, but each is a text-book of theoretical, rather than applied, mechanics. All have much the same scope, covering the statics, kinematics and kinetics of particles and of rigid bodies. Two of the books—those of Maurer and Stephan—agree somewhat closely in order of treatment, beginning with statics and following with kinematics and kinetics. Ziwet, on the other hand, begins with geometry of motion and kinematics, follows with an introduction to dynamics (statics being treated as a special case) and concludes with kinetics. In all the treatment is mainly restricted to the simpler force systems and the simpler cases of motion. Of the three books that of Stephan is the most elementary in treatment, while that of Ziwet would probably be the most difficult reading for the average student beginning the subject in its usual place in a course in engineering.

As features of Maurer's book may be mentioned the emphasis everywhere given to the vector nature of the quantities dealt with, the parallel treatment of graphical and analytical methods in statics, the admirable chapter on work and energy, and the satisfactory treatment of the subject of units. Professor Ziwet also gives prominence to vector notions, and also includes graphical methods in statics, though less fully than Maurer. His book contains no systematic presentation of the theory of energy, though the main features of the theory may be gathered from detached passages. His treatment of kinematics and kinetics is throughout more elaborate on the theoretical side than that of Maurer or of Stephan, and more use is made of general analytical methods. Stephan does not use the language of vectors. In statics he makes free use of graphical methods, but does not give the student the aid which comes from the use of Bow's notation for the designation of forces. His treatment of kinematics and of kinetics is relatively brief, and only the merest introduction to the theory of energy is given, potential energy not being mentioned.

Dimensional equations and the theory of units are explained by both Maurer and Ziwet, the former devoting to this subject an appendix of six pages. In Professor Ziwet's book (Art. 58) occurs an erroneous illustration which is likely to confuse the student: '* * * we have of course the proportion: 30 miles an hour is to one mile an hour as 44 feet per second is to one foot per second.' Both gravitational and kinetic systems of units are explained in each of the three books. The simple treatment of the engineers' kinetic system adopted by Maurer and Stephan should effectually clear away the traditional haziness surrounding the equation $m = W/g$. The unit mass is taken as a derived unit, and defined as the mass to which the gravitation unit force (the pound-force or kilogram-force) gives unit acceleration; this unit mass is thus equal to g pounds or g kilograms, and the equation expresses the reduction from one unit mass to another. The usefulness of a name for the unit thus defined will be agreed to even by those who hesitate to adopt the names *geepound* and *geekilogram* suggested by Maurer.

In considering the general question as to the best method of presenting the fundamental principles of mechanics in an elementary text-book, two requirements must be kept in view, soundness and intelligibility. Critics are by no means agreed as to what constitutes a sound formulation of the laws of motion.

Newton's laws have long held their place in the majority of English and American books, and in spite of the fact that the philosophical validity of the Newtonian system has been seriously questioned by able critics, this system, properly understood, still appears to furnish substantially the best foundation. It does not follow, however, that a literal translation of Newton's words is the best formulation of the laws of motion for the purpose of elementary instruction. That Newton's formulation is not easily understood by the beginner is tacitly recognized by most writers, much space being ordinarily devoted to explanations of the meaning of Newton's language. Without here attempting a full analysis, it may be profitable to suggest certain points in regard to which students may be aided by a departure from the usual method of stating and explaining the fundamental laws.

(1) Recognizing force as a fundamental quantity whose nature is known roughly, at least, from ordinary experience, its definition should be so stated as to include the fact that a force is exerted *by* a body. This should also be embodied in the statement of the first law, which might take the form 'a body uninfluenced by other bodies would move uniformly in a straight line or remain at rest.' It should also be embodied in the statement of the law of action and reaction: 'When one particle exerts a force upon another the latter exerts one upon the former, and the two forces are equal, collinear and opposite.'

(2) The full explanation of the second law should be preceded by a clear explanation of the meaning of acceleration as a vector quantity. The law itself might be stated as follows: 'A force acting alone upon a particle gives it an acceleration whose direction is that of the force and whose magnitude is proportional directly to that of the force and inversely to the mass of the particle.'

(3) The parallelogram law should receive explicit statement: 'Two forces acting simultaneously upon a particle give it an acceleration which is the vector sum of the accelerations which would be due to the forces acting separately.' 'Two forces acting simultaneously upon a particle are equivalent to a single force equal to their vector sum.' These statements are seen to be equivalent by virtue of the second law. An experimental statical proof of the parallelogram law is instructive, but its acceptance as an exact law rests on the same basis as that of the rest of the laws of motion—the apparent exact agreement of these laws with all experience.

Without entering into a detailed account of the treatment of the laws of motion in each of the three books under review, it is of interest to notice the different methods of defining and explaining force. Maurer's treatment is in close agreement with that here suggested; the point emphasized in (1) is explicitly stated at the outset, and the above statement of the law of action and reaction is in Maurer's words. Stephan gives the common but vague definition of force as the cause of a change of motion, the elementary but important fact that a force is always exerted by a body being explicitly stated only at the end of the three pages devoted to the preliminary explanation of force and of the law of action and reaction. In Ziwet's book the treatment of force oscillates between two different points of view. Force is defined mathematically as the product of the mass of a particle into its acceleration, and the author evidently agrees with those who regard force as a fiction, while he does not find it easy or advisable to discard the conception of force as a cause of motion in explanations addressed to beginners. The definition of force as the product of mass into acceleration, and the denial of force as a physical reality, are in harmony with what is, perhaps, the prevailing view among philosophical critics. Such a view is, however, wholly meaningless to the beginner, and it must be insisted that the treatment of force in an elementary text-book should build upon common notions and everyday experience.

Although, in an elementary text-book, logical rigor is not to be too strictly insisted upon, it is important to avoid false logic, and especially the appearance of logically proving what is really assumed. At certain points many current expositions of the principles of mechanics appear to be open to criticism on the ground of false or defective logic.

Consider, for example, Stephan's treatment of the law of composition of forces, which is substantially identical with that found in many text-books. In Art. 69 is the statement: 'If several forces act simultaneously upon a particle, the acceleration which each force imparts to the particle is independent of the existing velocity and of the action of the other forces.' For the explanation of simultaneous accelerations and of the method of combining them reference is made to Art. 66. But this explanation relates to a particle having a certain motion with respect to one base of reference, while this base is itself in motion with respect to a second base, so that the two 'simultaneous accelerations' refer to different bases or axes of reference. This throws no light on what is meant by simultaneous accelerations of a particle when only a single base of reference is in question. In the composition of forces we are not concerned with moving axes,* and in the analysis of motion with respect to any single base it is only by an arbitrary use of language that a particle can be said to have at the same time two different accelerations. Its actual acceleration may, of course, be expressed as the vector sum of components, but this may be done arbitrarily and in any number of ways; in choosing a particular set of components and associating each with a force we are merely *assuming* the parallelogram of forces.

From a logical standpoint the treatment of the theory of energy is an unsatisfactory feature of many text-books. Commonly energy is defined as the 'capacity of a body to do work,' or as the 'quantity of work a body can do,' while the meaning of work as done by a body is nowhere explained, work being defined only as done by a force. Another logical defect is to make $\frac{1}{2}mv^2$ the definition of kinetic energy instead of proving from a general definition of energy that a particle possesses by virtue of its motion the quantity of energy $\frac{1}{2}mv^2$. Of the three books under review, that of Professor Maurer is the only one that includes a logical and systematic presentation of the theory of energy.

Although the discussion of questions of terminology often seems fruitless, it may be worth while to refer to certain of these because of their importance as affecting the acquirement of sound notions by the beginner. That there has been little progress toward general agreement in the use of such terms as stress, centrifugal force, inertia force, is unfortunately due in part at least to the fact that discussions over them have involved more than mere questions of terminology.

The word stress is too often used vaguely, without attempt at exact definition. Among writers whose usage is clear, two definitions are current, which were formulated by Rankine and by Maxwell respectively. Rankine defined as stresses the forces which the particles of a body exert upon one another to resist strain (*i. e.*, departure from the 'natural' configuration). By Maxwell the action and reaction between any two portions of matter was called stress.* The usage of engineers, so far as it is definite, usually conforms more or less closely to the former definition, while the latter has been adopted in a number of works on both theoretical and applied mechanics. There are reasons in favor of each of these definitions, but it is to be regretted that the writer of a text-book should depart from both. Professor Ziwet apparently uses stress to designate any pair of equal and opposite forces in the same line, whether constituting an action and reaction or not. This sacrifices the chief value of Maxwell's definition, which is that it keeps clearly before the mind the fact that every force has its reaction and that action and reaction act upon different

* It is worth while to emphasize the argument by remarking that the accelerations of a particle with respect to two different sets of axes are not related by a simple parallelogram law unless the relative motion of the two bases is a translation. A full logical analysis of the laws of motion, including the parallelogram law, must include a consideration of the meaning of absolute and relative motion—a question which may well be omitted from an elementary book and which will not be entered into here.

* See Rankine's 'Miscellaneous Scientific Papers,' p. 120; Maxwell's 'Matter and Motion,' Chapter III. It should be said that neither author used the word in a uniform sense throughout his writings.

portions of matter. One of the most common and vicious errors is that action and reaction are counterbalancing forces. This error will inevitably be made if stress is defined as action and reaction, and then used to designate a pair of counterbalancing forces. Professor Maurer's usage, while departing from both the above definitions, is clear and consistent. He defines stress as any force whose place of application is a surface.

Most present-day text-books, including the three before us, define centrifugal force as the reaction which a particle constrained to describe a curved path, or a rigid body constrained to rotate about a fixed axis, exerts upon the constraining body. This definition is clear, and would be satisfactory if it were not inconsistent with general usage in the only class of problems in which the term is really needed—*i. e.*, problems in which motion is referred to rotating axes. It is convenient in such cases to give the equation of motion of a particle the same form as if the axes were fixed, introducing such fictitious forces as would produce the accelerations actually due to the motion of the axes. One component of the fictitious force for each particle is the centrifugal force, which is thus not a reaction exerted by the particle but a force assumed to act upon it. This must be regarded as the legitimate use of the term centrifugal force. Inconsistency in the use of this term in elementary text-books is responsible for much confusion in the mind of the student. An example of this inconsistency occurs in Stephan's book, pp. 279, 281. Centrifugal force is defined as the reaction exerted by a particle upon the body which deflects it from a straight path. But in the discussion of the belt and pulley an element of the belt is said to 'experience' a centrifugal force.

So much confusion of thought has been shown in discussions of 'inertia-force' that it seems desirable to drop the term entirely. Those who use it often appeal to the authority of Newton; but it is well known that Newton did not restrict the word force to its present specialized meaning, and that which he meant by force of inertia is not force at all in the present meaning of the word. Professor Ziwet defines force of inertia of a particle as the reversed effective force, *i. e.*, a force $-mj$, m being the mass of the particle and j its acceleration; and he explains that this force is exerted not on the particle but by it, being the reaction to the force which acts upon the particle to produce its acceleration. A student who compares this statement with the following (p. 160) is likely to be somewhat bewildered: "The fact that any change of motion in a physical body is affected by its mass is sometimes ascribed to the so-called 'inertia,' or 'force of inertia,' of matter, which means, however, nothing else but the property of possessing mass." This latter statement is practically Newton's explanation of force of inertia.

The preceding definition (also given by Stephan) is sanctioned by various writers of high authority. It may, however, be doubted whether there is any real need of a term to designate the reversed effective force $-mj$; at all events the term inertia-force used in this sense seems inappropriate and misleading. The nature of the action to which we give the name force does not depend upon whether the body exerting it has or has not acceleration. Suppose, for example, that a particle is acted upon by two bodies only, A exerting a force P upon it and B a force Q, and let R be the vector sum of P and Q. The particle reacts upon A with a force $-P$ and upon B with a force $-Q$; there is no body upon which it exerts a force $-mj = -R$. The 'inertia-force' is thus merely the vector sum of two forces exerted by the particle upon different bodies. There is nothing peculiar about these forces, and no reason why either of them should be attributed to the 'inertia' of the body. If P and Q become equal and opposite, the so-called inertia-force becomes zero, but the nature of the forces P and Q and of the reactions to them is unchanged. Neither is the nature of P or of its reaction changed if Q ceases to act; there is no more reason in this case than in the preceding for attributing the force exerted upon A to the inertia of the particle.

L. M. Hoskins.

Stanford University.

SCIENTIFIC JOURNALS AND ARTICLES.

THE November-December number of *The Journal of Geology*, which is the final one of Vol. XII., contains as the leading article Professor Wm. M. Davis's address before the Department of Earth Sciences in the World's Congress of Science and Arts at St. Louis on 'The Relations of the Earth Sciences in View of their Progress in the Nineteenth Century.' Dr. S. W. Williston contributes a 'Notice of Some New Reptiles from the Upper Trias of Wyoming' which were secured by the University of Chicago paleontological expedition of last summer. Four new genera and species are described. Messrs. S. R. Capps and E. D. K. Leffingwell describe the 'Pleistocene Geology of the Sawatch Range, near Leadville, Colo.' Professor Rollin D. Salisbury describes 'Three New Physiographic Terms' which are topographic unconformity, topographic adjustment and superimposed youth. O. W. Wilcox has an article 'On Certain Aspects of the Loess of Southwestern Iowa' and Miss I. H. Ogilvie describes 'The Effect of Superglacial Débris on the Advance and Retreat of some Canadian Glaciers.' The conclusion is 'that the débris covering, and that alone, is responsible for the advance, and indeed for the continued existence, of the glaciers of the eastern Rockies.'

The American Geologist for January contains a 'Biographical Notice of William Henry Pettee' with plate by Professor Israel C. Russell. Mr. George F. Becker's address before the Geophysical Section at the International Congress of Arts and Science at St. Louis on the 'Present Problems of Geophysics' is published. Professor J. F. Whiteaves contributes an article entitled 'Notes on the Apical End of the Siphuncle in some Canadian Endoceratidæ, with Description of Two Supposed new Species of Nanno,' which is illustrated by two plates. 'The Progress of Vertebrate Paleontology at the American Museum of Natural History, New York,' is reported by Mr. O. P. Hay. 'The Comparative Accuracy of the Methods for Determining the Percentages of the Several Components of an Igneous Rock' is discussed by Mr. Ira A. Williams. Mr. W. C. Morgan considers 'The Origin of Bitumen,' and from the discovery of a fossil egg partly filled with asphalt concludes that 'natural conditions are thus demonstrated to be sufficient to transform animal matter into bitumen during long periods of time without the aid of heat.' There are also given abstracts of papers presented at the Philadelphia meeting of the Geological Society of America by Professors Cumings, Tarr and Willis and Mr. Fuller.

The Popular Science Monthly for February contains the following articles: 'An Address on Astrophysics,' W. W. Campbell; 'The Metric System of Weights and Measures,' E. A. Kennelly; 'A Botanical Laboratory in the Desert,' Francis E. Lloyd; 'How Immigrants are Inspected,' Allan McLaughlin; 'On the Relations of the Land and Fresh-Water Mollusk-Fauna of Alaska and Eastern Siberia,' William Healey Dall; 'Examinations, Grades and Credits,' J. McKeen Cattell. In 'The Progress of Science' are to be found accounts of 'Convocation Week,' 'The American Association,' with portraits of the vice-presidents, 'The Presidential Address' and 'The Affiliated Societies.'

Bird-Lore for January-February has 'A New Year's Suggestion' on nesting trays for robins, by Mabel Osgood Wright; 'Nesting Boxes'—illustrated—by E. H. Forbush; Nest-Box Suggestions; 'On the Construction of Houses for the Purple Martins,' J. Warren Jacobs; and Nest-Box Notes. There is *Bird-Lore's* Fifth Christmas Bird Census and the eighth paper on 'The Migration of Warblers' by W. W. Cooke. The number contains the Report of the National Association of Audubon Societies, which includes a History of the Audubon Movement, Report of the National Committee for 1904 and the State Reports.

The American Museum Journal for January bears the subtitle Fossil-Carnivore Number, over one half its sixty pages being devoted to a synopsis of fossil carnivores, marsupials and small mammals in the American Museum of Natural History. The article, which is by W. D. Matthew, is well illustrated and accompanied by a list of important books of reference. The number contains a description of 'The Cape York Meteorites,' notes on the additions in various departments and lists of the various lecture courses.

SOCIETIES AND ACADEMIES.

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

The regular monthly meeting of the section was held at Fayerweather Hall, Columbia University, on Monday evening, November 7, with Professor Charles L. Poor in the chair. Abstracts of the papers which were presented before the section are as follows:

The Relation of Kathode Resistance to the So-called Saturation Current in the Discharge through Gases: F. L. Tufts.

In this paper it was pointed out that the so-called saturation currents obtained by Wilson and other investigators of the phenomena of electrical conduction through flame gases were not true saturation currents, but only apparently so, owing to the development at the kathode of a high resistance when the impressed electromotive forces were over a few volts. By the use of a kathode coated with calcium oxide and heated by a separate flame it was shown that the resistance of a flame connecting this with the anode remained practically constant; that is, the current through the connecting flame increased directly as the potential gradient for gradients ranging from a few tenths of a volt to the centimeter, up to gradients of as much as fifty volts to the centimeter.

Experiments were made with the ordinary luminous gas flame as well as with flames rendered non-luminous by the admixture of air, and the relation between current and potential gradient was found to be the same for both kinds of flames.

The Duration of the Afterglow Accompanying the Electrodeless Discharge at Low Pressures, Effect of Temperature: C. C. Trowbridge.

The purpose of the investigation was to determine the nature of the glow that often appears after the cessation of the electrodeless discharge in gases at low pressures. Measurements made thus far on the duration of the glow in air show a sharp maximum of duration between .1 and .05 millimeter pressures and that this maximum point varies with the electrical conditions of the experiment. It was also determined that there is a critical point between .7 and .3 millimeter pressures where the glow is only occasionally formed, after which as the pressure is further reduced, the duration of the glow increases rapidly to the maximum. The electrodeless discharge was also made to take place at liquid air temperature and it was found that the afterglow accompanying the discharge was diminished considerably in duration and intensity at the low temperature of about — 186° C.

The officers of this section for 1905 were then elected and are as follows:

Chairman—Ernest R. van Nordroff.
Secretary—Charles C. Trowbridge.

The next regular meeting of the section was held on Monday, December 5, with Professor William Hallock in the chair in the absence of Professor Poor.

The papers of the evening were as follows:

The Combination of Ions with the Solvent in Solutions: C. W. Kanolt.

The object of Dr. Kanolt's investigation was to determine whether or not the ions of a salt in solution are combined with the solvent. The method used was the electrolysis of a salt dissolved in a mixture of two solvents, with the subsequent analysis of the portions of the solution around the two electrodes. If the ions are combined with either of the solvents, this solvent will be carried from one electrode to the other, and changes in the proportions of the two solvents are to be expected. Positive results were obtained with silver nitrate dissolved in a mixture of pyridine and water, indicating that pyridine was combined with the silver ions. With the same salt in a mixture of alcohol and water only negative results have so far been obtained. Other salts are being investigated.

Chemical Combination of Knall-gas under the Action of Radium: Bergen Davis and C. W. Edwards.

The experiments described relate to the chemical combination of hydrogen and oxygen under the action of radium rays. The gases were enclosed in a vessel in such a way that a small change of pressure could be observed. About four milligrams of radium bromide were dissolved in alcohol and deposited on the surface of a small sheet of platinum which was placed in the vessel.

By means of electrodes the amount of ionization produced in the gas by the radium was measured. While the rate of formation of water was quite slow, yet the number of molecules of water formed for each physical ion produced was very large. The experiments are being continued by Professor Edwards.

C. C. TROWBRIDGE,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 593d regular meeting, the 34th annual meeting, held December 24, 1904, the following officers were elected:

President—G. W. Littlehales.

Vice-Presidents—Cleveland Abbe, J. G. Hagen, A. L. Day, L. A. Bauer.

Treasurer—Bernard R. Green.

Secretaries—Charles K. Wead, Lyman J. Briggs.

General Committee, besides those named above —W. A. De Caindry, H. M. Paul, J. Winston, L. A. Fischer, R. A. Harris, E. B. Rosa, C. G. Abbott, K. E. Guthe, W. S. Eichelberger.

The secretaries' and treasurer's reports showed that the society is in a prosperous condition, having had a considerable increase of membership during the past year.

THE 594th regular meeting was held January 7, 1905.

The first paper was by Mr. E. P. Hyde, of the Bureau of Standards, by invitation, on 'Some Problems of Photometry.' These related mainly to the rating of electric incandescent lamps, and to practical methods of obtaining the mean spherical illumination applicable to the various forms of lamps with their widely differing filaments and distribution curves. In the Matthews photometer there are a number of pairs of mirrors, the centers of one set lying in a meridian of the lamp and throwing the rays to the mirrors of the other set, whence they go to the screen. The lamp is rotated about 180 times per second. The speaker had determined the angular position of the mirrors of the first set that would give theoretically accurate results for three extreme cases of distribution, and then found an average position that reduces materially the small errors of the Matthews instrument.

Mr. W. J. Spillman, in charge of the forage plant investigations of the Department of Agriculture, then spoke on 'Utilizing the Desert,' dealing with the cactus and its uses, and showing many slides.

It has been found that the cactus plant possesses considerable value as feed for cattle, sheep and hogs. It is universally used by Mexican freighters in southwest Texas for their work oxen, and in famine years it is used by stockmen generally to tide over the dry periods, and for this purpose it possesses great value. The possibility of utilizing cactus frequently saves the wiping out of vast herds of cattle in time of famine. Several methods are in vogue for getting rid of the spines preparatory to feeding cactus. One of the most common is to scorch off the spines over a brush fire. A modification of the plumbers' torch is more or less extensively used for treating cactus in place. Many stockmen use a specially constructed cutting machine which pulps the cactus and abrades the spines so that the juices of the plant quickly render the spines innocuous. The pulped material is readily eaten. Some steam the cactus in large vats, which so softens the spines that they become harmless. Some varieties of cactus will thrive with one rain a year; and averaging a period of years an acre of cactus is equal to an acre of ordinary forage plants.

AT the 595th meeting, January 21, 1905, Dr. Guthe exhibited a bar of Heusner's alloy composed of 60 per cent. copper, 27 per cent. manganese and 13 per cent. aluminum, which is strongly magnetic, though none of its constituents is so.

Mr. Abbott exhibited and described 'A Comparator with Planimeter Attachment' especially devised for reading ordinates, abscissæ and areas of curves on 10-inch by 24-inch photographic plates. In connection with the spectrobolographic determinations of the solar constant of radiation at the Smithsonian Observatory, it is desired to know the variations in ordinates of bolographic curves corresponding with the intensity of rays of different wave-lengths in the solar spectrum, and further to sum up the areas included under such curves corresponding to the total energy of radiation reaching the bolometer.

The machine shown was constructed after Mr. Abbott's general design by Warner & Swasey, and consists, like the ordinary comparator, of a microscope moved by screws in ordinates and abscissæ, but this is here combined with a cone and rolling disk. The disk moves horizontally along the elements of the cone as governed directly by the position of the microscope in ordinates, while the number of revolutions of the cone is proportional to the motion of the microscope in abscissæ. Accordingly the number of rotations of the disk is proportional to products of ordinates and abscissæ, and by passing along the contour of the curve between given abscissæ, and back over the zero line to the original starting point, the difference in reading of the disk counter yields the area.

As constructed, the machine is best suited to areas of more than ten square centimeters, but a smaller machine would doubtless be equally successful. The accuracy of measurement actually reached with the instrument shown is 0.1 square centimeter, and numerous measurements of circles and other areas to this degree of accuracy were cited.

Mr. F. E. Fowle, Jr., also of the Smithsonian Observatory, then discussed 'The Discrepancy between Solar-Constant Measures by the Actinometer and by the Spectro-Bolometer.' He referred to Mr. Langley's proof that actinometric extrapolation by Bouguer's formula gives necessarily too low values for the extra-atmospheric solar radiation. It is, however, found by comparison with spectrobolometric determinations that the discrepancy is nearly constant and is about 14 per cent. for such atmospheric conditions as exist at Washington, when Ångstrom's actinometer is used.

Further refinements to the correction may later be determined as functions of the slope of the actinometer curve, the humidity and the air masses serving for the extrapolation.

Charles K. Wead,
Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 395th regular meeting was held at the Assembly Hall of the Cosmos Club on January 14, 1905, with President Knowlton in the chair and forty-six persons present.

Dr. A. D. Hopkins showed specimens of what are undoubtedly fossil borings, probably by some beetle of the family Cerambycidæ.

Professor W. P. Hay renewed a discussion from a previous meeting, and stated that proper credit is given in the scientific world to Cæsalpinus for the discovery of what we commonly know as the circulation of the blood.

Mr. C. O. Townsend presented a paper on the 'Distribution and Development of the Sugar Beet Industry,' in which he called attention to the difference between the sugar beet and the beet sugar industries. Of the latter he illustrated by lantern slides some of the largest beet sugar factories, the largest being in southern California. He then showed a very instructive series of slides dealing with the sowing, cultivation, harvesting and shipping of the sugar beet crop, including views of the workers employed, machinery used and results gained.

Mr. A. C. Veatch discussed 'The Question of Origin of the Natural Mounds of Louisiana, Arkansas and Texas' (illustrated with photographs). Of the many theories of origin suggested for these mounds three deserve the most careful attention: (1) the spring and gas vent theory, (2) the dune theory, and (3) the ant hill theory.

In the spring and gas vent theory it is argued that the gas produced by the decay of the large amount of vegetable matter buried in the coastal plain strata has, with the artesian water associated with it, brought to the surface fine sand and built up low cones. Small cones are now forming in this manner at many points in the coastal plain, and they were pointed to as proving this hypothesis. The fatal objection to this theory is that entirely identical mounds are found in Indian Territory on flat plains underlaid by higher inclined carboniferous shales and sandstones, where the substructure clearly lacks the elements required by this hypothesis.

The dune theory is based on the resemblance of these mounds to the low dunes which collect in the semi-arid region of the west about clumps of low vegetation. The objection to this theory is the great irregularity of wind-made features and the very notable uniformity in size and exact resemblance, one to another, of these natural mounds of the south central United States over an area at least 300 miles wide and 500 miles long. It would seem that in so large an area a wind origin would involve a greater variation in size than has been observed, and necessitate the presence of occasional dunes, or lines of dunes, of noteworthy size, whose origin could not, in any way, be doubted.

In the ant hill theory two possible lines of development were suggested: (1) that the mounds are the work of the atta, or leaf-cutting ants, (2) that they are the remains of hills of the mound-building variety of white ants, the termites. According to Professor W. M. Wheeler, atta hills in western Texas reach a diameter of forty to fifty feet and height of one to two feet; and Mr. E. A. Schwarz, of the National Museum, reports that the atta hills in Cuba often reach a height of ten to twelve feet and a diameter several times as great. These occurrences add greatly to the possibility of an ant origin.

Regarded as the work of mound-building termites, which are now restricted to the tropical regions, these mounds suggest a warmer and moister climate. Modifications such as those which permitted large elephants, camels and animals of the sloth and armadillo families to live in this region would also have permitted these, now similarly restricted mound-building termites, to do the same; and the causes which resulted in the extinction of the larger animals would also, though at a later date, have destroyed the mound-building termites.

Of the theories of origin yet suggested none are entirely satisfactory, and the dune and ant hill theories are the only ones well supported. If either of these hypotheses is correct the mounds are indications of important climatic changes in very recent time. It was suggested that the matter should be approached by the careful excavation of a number of these mounds at widely different points in order to fully determine the relation of the mounds to the beds which underlie them and to the soil surrounding them.

The last paper of the evening was by Mr. A. S. Hitchcock on 'The Twigs of Woody Plants with Deciduous Tips.' Woody plants in our latitude ordinarily form well defined winter buds at the time of elongation of the season's growth in late spring or early summer. Such growth is often referred to as definite or determinate. In some plants such as the willow the growth of the twigs continues during the season and is retarded and finally stopped by the advent of winter. Some plants have the habit of casting or sloughing off the terminal portion of the young twig at a definite point much as a leaf is cast in autumn. Such twigs present a scar at the end and, instead of a terminal bud, as in hickories or walnuts, the uppermost lateral bud continues the growth of the stem. Examples of this method are the elms, basswood and many other woody plants with two-ranked leaves. The tip of the twig is usually cast in the summer when the buds are formed. The speaker called attention especially to the twigs of the common sumac (*Rhus glabra*) gathered in December which showed remarkably long terminal portions of the twigs still attached but with the well-defined delimiting layer separating the healthy ripened wood from the dead terminal portion (five or six inches) which would be cast off during the winter.

E. L. Morris,
Recording Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

The Onondaga Academy of Science held its January meeting in Lincoln Hall of the high school building, at Syracuse, on the evening of the twentieth. Dr. John M. Clarke delivered an able address on the subject, 'Niagara Falls of the Future.'

The speaker, disclaiming any purpose of antagonizing the splendid industrial development at Niagara, invited attention to the paramount claim of the world to this famous spot as against the commercial claim which threatens to convert it into dollars, and by so doing make an end of the American Falls. The recent comment of Lord Kelvin, that the falls would have to be absorbed to meet industrial demand, was criticized as the expression of the sterile sentiment which has permitted the destruction of the classic Falls of Lodore and has already half ruined the Falls of Montmorency. The speaker insisted that industrial progress must leave something to the higher life, to the play of the finer emotions, and from such a view point no justification or compensation can be found for the destruction of such a stupendous display of nature's power.

Though it seems to the casual observer that nothing man can do could abate the enormous volume of waters descending in this cataract, and accomplished hydraulic engineers have been known to deride the possibility that the falls would be injured, yet the menace to the perpetuity of the American Falls is immediate and imminent. The volume of water descending at Niagara has been measured on several occasions with slightly divergent results giving as an average which has been accepted in the calculations of the engineers 224,000 cubic feet per second. This falling an average of 150 feet is equivalent to a potential horse-power of 3,800,000, not of between five and six millions as is constantly stated in the estimates and reports of the engineers.

The legislature of New York has chartered nine companies for the development of power at this place, all but two to take water from above the falls and return it below, one of these two proposing not to return it to the river at all, but to carry it to Lake Ontario by another passage, the other purposing to take advantage alone of the fall in the gorge below the cataract. Of these nine companies, no one of which is required to pay a franchise to the state for its tremendously valuable privileges and some of which are permitted to take unlimited water for their purposes, but two are now actively producing power, and it is believed that but one other is now preparing to do so. The two producing companies are limited by law in the amount of water they may consume, the last named is not. The producing companies are far within their limitations at the present, but in both the waste of water and of power is appalling. The series of small cataracts which cover the American bank just below the steel arch bridge, which are the waste discharges from the power canals and the unused fall of the power tunnel which discharges near the same spot, indicate that but a fraction of the potential power of the water now taken from the American river is utilized. The salvage of this wasted power, however, has begun, and its utilization will be continued by the building of factories along the edge of the water beneath the cliff. To save the wasting power of these companies the place must be even worse disfigured than it is at present.

The Canadian companies, three in number, have now in part completed their installment; in so doing, however, they have taken from the river great sections of the stream for their forebays and permanent construction. These companies when working will pay a substantial annual return to the commissioners of the Queen Victoria Park.

The immediately contemplated abstraction of water by the six active companies is:

	Cu. ft. per Second
Two American companies	16,300
Three Canadian companies	32,100
	48,400
It is estimated that the third active American company will consume	10,000
	58,400
The Canadian engineers have proposed four additional power works with a total abstraction of water of	29,996
	88,396

The following abstractions from this drainage basin are assumed as constants and are not here taken into consideration.

Chicago drainage canal	6,000
Proposed barge canal	1,200
Welland canal	600
	7,800

It is a matter of measurement that but one fourth of the water in the Niagara River passes over the American Falls. The sill of the falls is ten feet higher on the American side than on the Canadian. How easily the water is driven entirely out of the American channel is seen by the ice dams of the past few years, which, gorging the stream from the upper end of Goat Island to the American side, have turned the water from that channel so that one can cross the bed of the river dry-shod. Let then, from one fourth to one third of the water be permanently abstracted from the river, and the American Falls will be permanently dry. The production of power actual and immediately contemplated by the five companies within their charters will consume 48,400/224,000 of the water, or 1/5 —. With the estimated abstraction of water by the sixth (American) company this fraction becomes 58,400/224,000 or 1/4 —. Should the proposed additional Canadian plans be effected the proportion will become 88,396/224,000 or 1/3 —. In any one of these cases the danger limit is reached and the perpetuity of the American Falls now hangs by the slender thread of improbability that these companies shall produce to their statutory limitations or find a market for their product.

It is authentically stated that 800,000 tourists visit Niagara annually, bringing an enormous revenue to the place. As soon as the world learns that New York and Canada have shorn this famous place of its beauties, this source of industrial prosperity will be gone. While these magnificent schemes of power development are putting to shame a sentiment of proper pride which should be national rather than local, unlimited horsepower lies idle in the region where these companies hope to find their market and in the development of this none of the finer manifestations of natural power and none of the finer sentiments of mankind would be assailed.

The address was a strong presentation of the subject and the press of the city joined in the protest against the destruction of the falls.

J. E. Kirkwood,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE.

CONSULTING EXPERTS IN LIBRARIES.

To the Editor of Science: Dr. Francis B. Sumner's letter, published in Science, January 13, seems to offer an appropriate opportunity for calling attention to certain noteworthy developments at the Library of Congress during the administration of Dr. Herbert Putnam. Dr. Sumner urges the desirability of employing, in connection with one of our great libraries, 'a staff of consulting experts, men of the rank of college professors, whose duty it should be to furnish definite bits of information in response to legitimate questions, or, at least, to guide the seeker on his way * * * the establishment of a sort of human encyclopedia as an adjunct to the library.'

While this ideal has not yet been attained at the Library of Congress, a remarkable development in this direction has taken place during the last few years. It is the function of the Division of Bibliography, established in 1900, not only to prepare and publish lists of references on special topics, principally those of current political interest, but also to supply bibliographical information in reply to inquiries received by mail. The reference work of this character has been mainly in the fields of social and political science and history.

As, however, the collection of scientific literature has recently been reclassified and is now in process of being recatalogued, it has become possible to undertake similar work in science. There are on the staff of the library at the present time several specialists representing different sciences, and it is always possible to consult others associated with various branches of the government service. Furthermore, it being part of the policy of the Librarian of Congress to make the collection of bibliographies, indexes, library catalogues, etc., as complete as possible, unusual resources in the way of bibliographical tools are available at the library. A Science Section of the library, in charge of the undersigned, has accordingly been organized recently and one of its functions is to carry on the reference work in this field, both for investigators at the scientific bureaus in Washington and in answer to legitimate inquiries by mail.

Under these circumstances it seems that the facilities now offered by the Library of Congress meet the need indicated in Dr. Sumner's letter to a very considerable extent, and further advances in this direction will occur if it appears that valuable service can be rendered.

I conclude by inviting the readers of Science to make use of these new facilities whenever the library resources to which they have access are inadequate to the needs of the investigations which they have in hand. Communications should be addressed to the Librarian of Congress, and should be marked 'Science Section' if they are inquiries referring to the mathematical, physical or natural sciences.

J. David Thompson.

THE STORAGE OF MICROSCOPIC SLIDES.

To the Editor of Science: In your issue of December 30 you published an article by C. L. Marlatt, of the U. S. Department of Agriculture, describing a method of storing and indexing microscopic slides.

The Bausch and Lomb Optical Company have designed and are selling an excellent cabinet with card system which has all the advantages claimed by Mr. Marlatt for his and lacking only the envelopes, which I can not but think must be somewhat inconvenient.

These cabinets are made in three sizes, holding 500, 1,500 and 3,000 slides respectively. Tiers of trays, each running in its own groove, are constructed to take slides of various sizes. At the bottom are drawers (one, two or three) containing separate cards for every slide, on each of which is printed a form for registering the slide: Tray No.—Series No.—Name of Slide—Stain—Mounted in— and two lines for other data. There are also printed guide cards from A to Z.

The objects being recorded on separate cards, the removal of slides necessitates simply the removal of its corresponding card, while the addition of slides requires only the filling out and insertion of new cards. Classification thus, it will be seen, becomes exceedingly simple. The slides may be rearranged and the collection increased or diminished with the least possible amount of trouble.

Josephine Shatz.

Rochester, N. Y.,
January 8, 1905.

SPECIAL ARTICLES.

DOPPLER'S PRINCIPLE AND LIGHT-BEATS.

There is a beautiful lecture experiment in illustration of Doppler's principle due, I believe, to Koenig. A vibrating tuning fork of high pitch, say 2,000 vibrations per second, is moved to and fro near, and at right angles to, a reflecting wall. The waves coming from the fork and (virtually) from its image back of the wall are changed in length by the opposite motions of fork and image with the result that very audible beats are heard. With a fork of the pitch mentioned, a speed of three feet per second gives beats at the rate of about eleven per second. Although special forks are made for this experiment, they are quite unnecessary. An ordinary C 512 fork of Koenig's pattern gives a very shrill tone when strongly bowed near the shank and answers the purpose admirably. If the fork is held stationary and the reflecting surface is moved, the effect is the same on account of the motion of the fork's image.

Attempts to secure visible beats by means of light waves of slightly different wave-length have met with no success, partly on account of rapid changes of phase, and partly because of the difficulty of securing two sources whose vibration frequencies are nearly enough equal. Thus if we assume (what is most likely not true) that the failure to observe interference fringes with differences of path greater than, say, 30 cm. indicates a change of phase, this would indicate 10^9 or more changes of phase per second. On the other hand, should we take the two D lines as sources there would be about 10^{12} beats per second. It is evidently almost hopeless to attempt to secure visible light-beats in this manner. If we consider Doppler's effect, however, the case is quite otherwise. The second form of Koenig's experiment, viz., that in which the reflector is moved, is in principle almost exactly analogous to Professor Michelson's interferometer.

In this instrument the alternations in brightness at any point in the field when the slide is moved are beats due to the Doppler effect just as truly as are those heard in the second form of Koenig's experiment.

Albert B. Porter.

Chicago,
January 14, 1905.

NOTE ON THE BROAD WHITE FISH.

In the *Proceedings* of the American Philosophical Society of Philadelphia, XLIII., 1904, p. 451, plates VIII. and IX., I have wrongly identified the broad white fish, or *Coregonus kennicotti* Jordan and Gilbert, as the humpback, or *Coregonus nelsonii* Bean. My error was due largely to lack of material, ignorance of the species from autopsy, and the fact, as I have since discovered, that *C. nelsonii* does not always exhibit the well-developed hump like that of the type. Possibly when the Siberian forms are carefully studied the nomenclatures of these fishes will be more stable.

Henry W. Fowler.

Academy of Natural Sciences,
Philadelphia, February 5, 1905.

*RECENT ZOOPALEONTOLOGY.**

During the past thirteen years great advances have been made in our knowledge of the ancient mammalian life of North America, especially through the explorations in the Rocky Mountain region carried on by the Carnegie, Field Columbian and American Natural History Museums. The long Tertiary period has been clearly subdivided into a series of stages and substages. This enables paleontologists to record more accurately than ever before the time of arrival and departure of the larger and smaller quadrupeds from North and South America, Asia, Europe, Africa, and to determine more precisely when the connection of North and South America was interrupted by a gulf flowing between the Atlantic and Pacific Oceans, and when the connection was again made by the elevation of the Isthmus of Panama; this demonstrates also that a very much closer connection existed between the animal life of Europe and of North America through continuous intermigration over the broad land area now submerged beneath the Behring Straits. A series of six world maps prepared by Dr. W. D. Matthew clearly exhibit this submergence and emergence of the isthmuses between these great continents.

Of especial interest is the recent discovery by the Geological Survey of Egypt that the whole race of mastodons and elephants originated in Africa, entered Europe in the middle of the Tertiary and soon afterward found their way into North America and somewhat later into South America. We have now been able to fix very positively the date of actual arrival of these animals in North America. It appears probable that successive waves of migrations of European and Asiatic species of elephants and mammoths came to this country. In the meantime there survived here from one of the earliest African migrants the eastern American forest mastodon which lived until comparatively recent times.

The theory of multiple races or polyphyletic evolution not only of elephants but of horses, rhinoceroses, camels and titanotheres appears to be clearly established through these recent discoveries. It was formerly believed, for example, that the modern horse had a single line of ancestors extending back into the Eocene period; now it appears that in North America there were always four to six entirely different varieties of the horse family living contemporaneously, including slow-moving, forest-living horses with broader feet, and very swift plains-living horses with narrow feet fashioned more like the deer. Intermediate between these arose the variety which survived and gave rise to the true modern horse. Furthermore, it appears that the modern horses separated from the asses and zebras at a much more remote period than has been generally supposed, and we are now endeavoring to ascertain accurately when this separation occurred.

The same discovery of multiple races has been made among the rhinoceroses. In Eu-

* Abstract of a lecture delivered by Professor Osborn before the Society of Naturalists at the Philadelphia meeting.

rope and in North America instead of forming a single line of evolution there were at least seven or eight nearly contemporary but distinct lines of rhinoceros succession, some of which can be traced back as far as the base of the middle Tertiary. The truly American rhinoceroses which appear to have branched out into several water-living, forest-living and plains-living types, were reinforced by the sudden appearance of the extremely short-limbed rhinoceroses which had evolved in Europe and came over to this country simultaneously with the earliest elephants or mastodons.

Another remarkable feature of this law of multiple evolution is that even where these varieties have evolved quite separately and independently, they still have inherited from remote common ancestors certain tendencies or potentialities of evolution which were latent but not expressed in the ancestral forms but which find a more or less simultaneous expression in the derived forms. Thus, among the rhinoceroses and titanotheres the rudiments of horns begin to appear more or less simultaneously in several of these multiple independent races or varieties, indicating a hereditary predisposition toward the development of certain organs quite unsuspected in the earlier evolutionary writings of Lamarck and Darwin. This predisposition to evolve certain structures tends to establish the idea that the laws of development are not controlled *solely* by the survival of the fittest as according to the original Darwinian theory, nor by the inherited effects of use and disuse as according to the Lamack-Spencer theory, but represent the budding out or expression of certain innate or inherited ancestral tendencies.

Among the greatest surprises in recent discovery has been the finding of armadillo-like edentates in the Rocky Mountain region near Ft. Bridger, Wyo., from rocks of the lower Tertiary period. These armadillos certainly bore a leathery if not a bony shield. Some ossicles indicating the presence of the bony shield are reported to be present in the collections of the Yale Museum; the remains thus far found by the American Museum exploring parties show a provision for the shield in the structure of the backbone but do not exhibit the bony elements of the shield itself.

Almost equally surprising results of ten years' exploration are the tracing back of the dog family into the Lower Eocene, of the saber-tooth tiger family into the Middle Eocene, of the camel family into the Upper Eocene, of the hedge-hogs (now extinct in this country) into the Lower Oligocene, of the raccoons into the Lower Miocene. The camel family, like the horses and the rhinoceroses, branched out into a great many varieties, short- and long-limbed, most remarkable among the latter being the giraffe-camel (*Alticamelus*), which, although a true camel, was closely similar in build to the giraffe. With these discoveries the names of Scott, Wortman and Matthew are honorably associated.

It has long been known that the deer, bear, moose, the oxen and sheep families did not appear in this country until very late in geological times, shortly before the Ice Age.

Among the many difficult and still unsolved problems is the cause of the total extinction of the horse in North and South America while it survived and multiplied in Europe, Asia and Africa. Just before the time of the extinction of the horse, America exhibited the greatest beauty and variety in the development of this family. As studied by Gidley, there were horses exceeding in size the enormous Percherons of to-day and there were also varieties smaller than the most diminutive Shetlands. Yet with all this wide range of variation all became extinct.

The elephants also exhibited three great varieties, the true mammoth (*E. primigenius*) to the north, the Columbian elephant in the central states, and the gigantic Imperial mammoth to the south, forms shown to be quite distinct by Lucas and undoubtedly adapted to various kinds of climate; yet all died out with the great wave of death which swept off the camels, horses and the giant South American sloths, just before or during the first advance of the Glacial period.

H. F. O.

SCIENTIFIC NOTES AND NEWS.

The senate of the University of Edinburgh has voted to confer its honorary doctorate of laws on Dr. Alexander Graham Bell, of Washington, and on Dr. W. W. Keen, professor of surgery at Jefferson Medical College, Philadelphia.

Dr. S. Weir Mitchell, the eminent physiologist, physician and author, celebrated his seventy-fifth birthday on February 15. Dr. Weir Mitchell will present candidates for honorary degrees at the celebration of the University of Pennsylvania on February 22. Degrees will be conferred on President Roosevelt and on the Emperor of Germany.

On the occasion of the opening of the new public health laboratory of the Victoria University, Manchester, honorary doctorates of science were conferred upon Professor Calmette, Lille University; Professor Perroncito, Turin University; Professor Salomonsen, Copenhagen University, and Captain R. F. Scott, R.N.

Professor K. Möbius has retired from the directorship of the Berlin Museum of Natural History. The position has been offered to Professor H. H. Schauinsland, director of the museum at Bremen.

Dr. Friedrich Paulsen, professor of philosophy at Berlin and known also for his works on education, will lecture at Harvard University during the first half of next year in accordance with the plan for an exchange of professors. As already noted, Professor Francis G. Peabody will lecture at Berlin.

Vice-Admiral Human has been elected president of the French Society of Geography.

Dr. George Bruce Halsted has been made foreign associate and honorary professor of mathematics in the popular university of Tempio, Italy, and a fellow of the Royal Astronomical Society.

'The Relation of Graduate Study to General Culture' was the subject of a lecture, given on February 3, at the University of Chicago, by Professor Josiah Royce, of Harvard University.

A conference on school hygiene, arranged by the Royal Sanitary Institute, was held in the University of London, under the presidency of Sir Arthur W. Rücker, on February 7–10.

Dr. Murgoci, professor of geology at Bucharest, is carrying on research work in California.

Dr. Burton E. Livingston, of the department of botany of the University of Chicago, has been appointed to the staff of the Bureau of Soils in the United States Department of Agriculture, and will begin his new work at the close of the winter quarter.

Dr. D. T. MacDougal has started on an expedition to lower Colorado and the upper portion of California to collect botanical specimens for the New York Botanical Garden and to study the flora of that region.

Miss Vera K. Charles, scientific assistant in the Bureau of Plant Industry, U. S. Department of Agriculture, has recently returned from the Isle of Pines, where she was collecting in the interest of the herbarium connected with the office of vegetable pathological and physiological investigations.

The Samuel D. Gross prize of the Philadelphia Academy of Surgery, for the year 1905, amounting to $1,200, has been awarded to Dr. James Homer Wright, of Boston, Mass., for his essay, 'The Biology of the Microorganism of Actinomycosis.'

The Wilde medal of the Manchester Literary and Philosophical Society has been awarded to Professor C. Lapworth, F.R.S., professor of geology at Birmingham.

The St. Petersburg Academy of Sciences has awarded the Lomonosoff prize of $500 to Professor N. A. Menschutkin for his researches in theoretical chemistry, and the Ivanoff prize to Professor P. N. Lebedeff, of Moscow, for his experimental researches on the pressure of light.

At a meeting of the trustees of the Percy Sladen fund, held recently at the rooms of the Linnean Society, London, grants were made to Mr. W. R. Ogilvie Grant towards the expenses of a collector for the British Museum in Central Africa; to Miss Alice L. Embleton to enable her to continue her investigations in insect cytology; and to Mr. J. Stanley Gardiner towards the expenses of an expedition to the Indian Ocean.

The Carnegie Institution of Washington has recently made a grant of $2,500 to Professor C. F. Burgess, of the department of applied electro-chemistry of the College of Engineering of the University of Wisconsin, to aid him in carrying out investigations upon the properties of pure iron and its alloys. During the past three years Professor Burgess has developed a method of producing iron electrolytically of a very high degree of purity, in a manner similar to that employed in the refining of copper. Previous to this work pure iron has been obtained only in very small quantities and at excessive cost, but Professor Burgess is now able to produce comparatively large quantities at a small cost, using for this purpose a cheap grade of steel. Careful analysis of this product fails to show the presence of any foreign element, with the exception of hydrogen, which can readily be driven off by heat. There is already a considerable demand for this iron for scientific purposes, and about half a ton has been made.

According to the New York *Evening Post* the grants made by the Carnegie Institution for scientific research include the following to Cornell: Professor Wilder D. Bancroft, for chemical study of alloys, $500; W. W. Coblentz, for study of infra-red emission and absorption spectra, $1,000; E. S. Shepard, for study of brasses and bronzes as alloys, $1,000.

We learn from *Nature* that an international committee has been formed in Heidelberg, under the presidency of Dr. A. Freiherr von Dusch, minister of education, of the Grand Duchy of Baden, with the object of honoring the memory of the late Professor Carl Gegenbaur, who for nearly thirty years was the director of the Anatomical Institute of Heidelberg. The committee has decided upon a life-size bust of Gegenbaur, to be executed in marble by Professor C. Seffner, Leipzig. The bust will be placed in the vestibule of the Anatomical Institute, probably in the early summer, at a date not yet fixed. The committee invites former pupils of the deceased master, and all those who have benefited from his epoch-making works on human and comparative anatomy, to send contributions, with their addresses and titles, to Professor M. Fuerbringer or to Professor E. Goeppert, both in Heidelberg. Every contributor will receive a picture of the bust, and casts may be obtained, on special application, from Professor C. Seffner.

A memorial service in honor of the late Professor Alpheus S. Packard was held at Brown University on February 18.

Dr. George Bond Howes, F.R.S., Huxley's successor as professor of zoology at the Royal College of Science, London, known for his contributions to vertebrate morphology, died on February 4, at the age of fifty-one years.

The Rev. Thomas Arthur Preston, who founded the Marlborough Natural History Society and Museum and who did much to promote nature-study in England, died on February 6, at the age of seventy-one years.

Dr. Julius Scriba, professor of surgery at the University of Tokio and the author of contributions on anthropology and botany, has died at the age of fifty-five years.

The United States Civil Service Commission announces that in view of the very small number of applications filed for the examination for assistant in the Philippine service, on March 1–2, this examination has been postponed to April 5–6, 1905, and will be held in different parts of the country, to secure eligibles from which to make certification to fill a large number of positions in the grades of clerk and teacher in the Philippines. As a result of this examination it is desired to secure 140 college graduates, including 20 polytechnic and 20 agricultural graduates, at a salary of $1,200 per annum, and 60 normal school graduates at a salary of $1,000 per annum. Many of the appointees will be required in the position of teacher, while some will be required in the various clerical and administrative offices in the islands. Excellent opportunities for promotion are afforded for well-qualified appointees. For positions requiring college graduates students who graduate in 1905 will be acceptable.

The United States Civil Service Commission announces an examination on March 8, 1905, to secure eligibles from which to make certification to fill a vacancy in the position of botanist (male) at $75 per month, in the National Museum, and vacancies as they may occur in any branch of the service requiring similar qualifications. The commission also invites attention to the examination for scientific aid, applications for which may be filed at any time. Eligibles are particularly desired at this time to fill a vacancy in the position of scientific aid (male) qualified in animal husbandry, in the Bureau of Animal Industry, Department of Agriculture, at $480 per annum, and other similar vacancies as they may occur in that department. For the specific vacancy mentioned, only such applications will be considered as are filed with the Commission at Washington prior to the hour of closing business on March 8, 1905.

THE N. Y. State Civil Service Commission will hold an examination on March 1, to fill the position of geologist in the State Museum at a salary of $1,500, and of taxidermist in the Museum at a salary of $900.

THE Court of Appeals of Maryland has just rendered a decision which establishes the constitutionality of the State Aid Highway Law of the last legislature, the administration of which has been by law placed under the control of the Maryland Geological Survey. The state survey has maintained a highway division during the past eight years, but has now placed at its disposal $400,000 annually, derived half from the state and half from the counties, for the construction of improved highways. The law becomes operative at once and surveys on a large scale will begin immediately.

THE Argentine gunvessel *Uruguay* has returned to Buenos Ayres after her long voyage in the Antarctic seas, having failed to obtain any news of the French Antarctic expedition under Dr. Charcot.

MR. DAVID SYME, of Melbourne, has given $15,000 to found a prize for the encouragement of original research in science. A prize of $500 and a medal will be annually awarded by the University of Melbourne.

THE London *Times* states that it received the following letter for publication from a correspondent who is a graduate of an English university, but presumably did not specialize in scientific subjects: "The Amount of Coal.—To the Editor of *The Times*.—Sir, —The amount of coal which has been dug out of the earth must be now so considerable as to make an appreciable diminution of the weight of our globe. Is it conceivable that in time this might cause an interference with the working of the solar system. All of the coal that remains behind is a small proportion, in ashes; the only addition that is made to the weight of the earth is by increase of population, and is infinitesimal. I am, Sir, yours faithfully, W. C. B."

MR. ANTONIO OLYNTHO, Brazilian commissioner to the Louisiana Purchase Exposition, has, by order of his government, investigated the organization and work of the division of hydrology of the U. S. Geological Survey. The underground water resources of Brazil, which are as yet almost entirely undeveloped, are said to be immense. It is the wish of the Brazilian government to encourage their development, and to this end it is proposed to organize a division of hydrology similar to that maintained by the U. S. Geological Survey. The investigation and development of artesian waters is of particular interest to the Brazilians. As compared with the work of bureaus in other countries, the investigations carried on by the U. S. Geological Survey of both surface and underground waters takes high rank, as is attested by the frequent calls from other governments for information and assistance. During the past year, the Colonial Office of Bermuda has sought advice from our Survey in regard to a water supply for that island, and the government of Peru has borrowed a hydrologist, who is organizing a bureau which is investigating the underground waters of that country in the special hope of obtaining supplies for the nearly rainless coast. The bureau which Brazil proposes to establish will be modeled after the survey's division of hydrology, the plan of which was furnished the commissioner from Brazil by Mr. Myron L. Fuller chief of the eastern section. The work in Brazil will differ, however, in one important particular from that in the United States. The drilling of test wells by the government survey has seldom been practicable here, but the government of Brazil, like that of Peru, expects to actually drill for water, and drilling outfits have accordingly been purchased in this country for that purpose.

UNIVERSITY AND EDUCATIONAL NEWS.

The University of Pennsylvania has asked from the state an appropriation of $650,000 to be used as follows: (1) University hospital—maintenance, $140,000; new building, $75,000; clinical amphitheater and laboratories for dispensary buildings, $35,000; (2) university—$175,000 for general maintenance, construction of buildings, and the purchase of apparatus; (3) veterinary department—$100,000 for the erection of a suitable building and equipment; (4) free museum of science and art—$125,000 for the construction and equipment of a building for the expansion of the department.

Mr. Charles H. Hackley, of Muskegon, Mich., has made public bequests, as follows: To the Hackley Manual Training School of Muskegon $250,000 is given, which, added to $360,000 already given by Mr. Hackley, makes the school's total endowment $610,000; as an endowment for the Hackley Hospital, $300,000, less any sum given during Mr. Hackley's lifetime for this purpose; for the maintenance of the Hackley Public Library, $200,000; for the purchase of pictures for this library, $150,000.

Mount Holyoke College will receive $172,000 as the residuary legatee of Edmund K. Turner.

The Drapers' Company have voted a further sum of £400 a year for five years towards the statistical work and higher teaching of the department of applied mathematics, and the Mercers' Company have voted £1,000 to the chair of physiology, in University College, London.

We learn from *The Experiment Station Record* that W. C. Stubbs, who has been since 1885 professor of agriculture in the Louisiana State University and director of the experiment stations, has voluntarily retired. He is succeeded by Professor W. R. Dodson, who becomes, by virtue of his office as professor of agriculture at the university, director of the three stations in the state, director of the State Geological Survey, official chemist, etc.

Mr. Thorne M. Carpenter has resigned his position as assistant chemist and assistant in the investigations with the respiration calorimeter, of the Agricultural Station of the Pennsylvania State College to accept a similar position in connection with the investigations on human nutrition at Wesleyan University. The vacancy has been filled by the promotion of Mr. N. C. Hamner, and Mr. W. A. Smith, a graduate of the college in 1901, has been appointed assistant chemist. Mr. J. B. Robb, of the Maryland Agricultural College, who has assisted in the respiration calorimeter investigations during the past three winters, has been temporarily engaged for the same purpose for the present season.

Mr. F. L. Shinn, assistant in physical chemistry at the University of Wisconsin, has just accepted a call to the University of Indiana, as assistant professor of physical chemistry.

M. Jonathan Rigdon, fellow of Clark University, has been appointed instructor in philosophy in Clark College.

Mr. H. H. Higbe, assistant in mechanical engineering at Columbia University, has been appointed instructor in the University of Michigan, and Mr. L. F. Parr has been appointed to fill the vacancy at Columbia University.

Mr. Edgar Schuster, M.A., New College, Oxford, has been appointed to the Francis Galton research fellowship in national eugenics.

Mr. I. L. Tuckett, M.A., of Trinity College, Cambridge, has been appointed demonstrator in physiology.

M. Michael-Lévy has been nominated by the Paris Academy of Sciences for the chair of inorganic chemistry at the Collège de France, vacant by the death of M. Fouqué. M. Cayeux is named as the second choice of the academy.

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SCIENCE

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FRIDAY, MARCH 3, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*APPLIED BOTANY AND ITS DEPENDENCE UPON SCIENTIFIC RESEARCH.**

UNFORTUNATELY for me, the time for this address before the Society for Plant Morphology and Physiology comes so far along in the twentieth century that there is opportunity for neither a retrospective nor a prospective view of botany, even were I competent to assume the rôle of an historian or a prophet. I had, therefore, thought of presenting a somewhat general discussion of some of the problems involved in soil bacteriology, but, fortunately for you, this has recently been done before another society by another investigator, so that there is no reason for digging over the same soil here. On the other hand, the discussion of some purely technical botanical subject connected with my particular field of work seems more properly to belong to that part of the program devoted to scientific papers. Consequently, by this process of elimination, the only question of general interest occurring to me seems to be that one which most of us have grown tired of answering and yet, because of the tendency of this age, is the one which we have to answer more often than any other, namely, Of what good is botany? Why do we teach it? and above all, Why have we as men and women allied ourselves with such a profession? Far be it from me to attempt to defend botany against all who are now engaged in its pursuit. These are matters for one's own conscience, but for those of us here, members of the Society

* Address of the president of the Society for Plant Morphology and Physiology, Philadelphia, December, 1904.

for Plant Morphology and Physiology and other societies in good and regular standing, I think, perhaps, it may be well to discuss for a short time the importance and significance of botany as a science and a profession, in order that those who are unfamiliar with the situation may realize that we have as distinct a part in the world's work as a banker, an engineer, or a bricklayer.

So hard pressed have scientific men sometimes been for an excuse for their existence, that I know of at least one instance where the reply of Cuvier to the practical jokers trying to frighten him by impersonating the devil, has been given as a legitimate reason for being acquainted with certain facts regarding the structure of animals. Perhaps you are not familiar with the story. It seems that Cuvier while a young man incurred the enmity of certain of his colleagues, who decided to give him a severe fright by dressing one of their number in the conventional garb of Satan and making a midnight call upon him. It is presumable that being aroused from a sound sleep, Cuvier was duly impressed with the figure before him and that some of the threats made were having the desired effect. But finally, in a last effort to overwhelm him, the devil threatened to eat the young scientist. This was a fatal mistake, for Cuvier, at once reassured, eyed the grotesquely-clad figure from head to toe and exclaimed, "What, horns and hoofs and carnivorous! Never!" He then rolled over and went to sleep.

Now, I can not maintain that the study of botany will enable one to detect the real devil from an impostor; neither do I consider that the botanist has any need for such knowledge. The particular use of the story, however, well illustrates, I think, how great has been the necessity at times for resorting to any means calculated to demonstrate the value of pure science to a certain class of people.

The test, of course, which nowayears is applied to any science or profession by a large part of the world is: What is it worth? How much money does it influence? What industries has it created? The money value of botany to those engaged in it, I will pass over in silence, it being impossible to say so little that a fair proportion would be maintained between the words and the compensation. But to those not teaching or studying it, those who have criticized botany and botanists for their lack of efficiency, and to the world in general, the value of our profession is so great that we may well feel proud to be among its numbers.

It may be regarded as an admission of weakness to even discuss the practical side of botany. But we who daily come in contact with the results obtained from our knowledge of plants are apt to forget that the large part of those engaged in other professions still look upon botany as it was considered fifty years ago, the whole function of which was so aptly described in the word to teachers by Mrs. Lincoln in 1845. She says: "In the first meeting of a botanical class, after some explanation as to the nature of the study they are about to commence, each member shall be presented with a flower for analysis." That this was the chief object of all subsequent meetings seems to have been taken for granted by many who have never had an opportunity of belonging to a class in botany. Perhaps it will be worth while to quote still further from this same book which served as an introduction to the subject for more than one of the sturdy pioneers whose names shall ever stand high on the roll of botanical achievement; for it is well to know how much foundation there is for certain opinions now held by the uninformed. In the introduction to

Mrs. Lincoln's 'Botany' you will find the following, 'The Study of botany seems peculiarly adapted to females,' and then, as if to justify this statement, she adds: "A peculiar interest is given to conversation by an acquaintance with any of the natural sciences, and when females shall have more generally obtained access to these delightful sources of pure enjoyment, we may hope that scandal, which oftener proceeds from a want of better subjects, than from malevolence of disposition, shall cease to be regarded as a characteristic of the sex. It is important to the cause of this science that it should become fashionable; and as one means of effecting this, the parlors of those ladies, who have advantages for intellectual improvements, should more frequently exhibit specimens of their own scientific taste. The fashionable *et cetras* of scrap books, engravings and albums do not reflect upon their possessors any great degree of credit. To paste pictures or pieces of prose or poetry into a book; or to collect in an album the wit and good sense of others are not proofs of one's own acquirements; and the possession of elegant and curious engravings, indicates a full purse rather than a well-stored mind; but *herbariums* and books of impressions of plants, drawings, etc., show the taste and knowledge of those who execute them."

We have here one result of the effect of botanical pursuits, which perhaps accounts for the well-known fact that botanists are freer from gossip and kindred vices than other scientists, and when we remember (if we may be allowed to quote once more) that this science is 'especially recommended to strengthen the understanding and improve the heart,' many things are made plain. But, seriously, the fact must be acknowledged that even at the present time there are altogether too many fair-minded people who have the idea that botany is a somewhat effeminate calling, and that while it does very well for ministers who have lost their voice, or for others who are unfortunately disabled, the taking up of the subject by an able-bodied man necessitates an explanation which is not always complimentary.

By hard work it has been possible within recent years to emphasize the pedagogical importance of botany, and the fact that accuracy, observation, discipline, etc., are inculcated by this subject has helped to raise it to something like the place it deserves in many curricula. But even here the struggle to differentiate botany from that all-containing, but often little-meaning term *biology* has usually resulted in most of the credit going to the animals instead of the plants. For while the improvement has been most encouraging in the last few years, it must be confessed that the proportion of botany to zoology in many biological courses is as that of copper sulphate to water in a reservoir treated for the extermination of algæ. But even after botany has received all credit due her from the purely educational standpoint, there is a vast majority who are still unconvinced of its worth and who think that the time of both student and instructor would much better be spent in some line that 'fits one for being of some account.' It is admitted by authorities that there are some subjects now taught whose only real claim for being maintained in schools and colleges is their pedagogical value. Botany is fortunate in having additional causes for its importance, and for this reason, if for no other, it should not rest its entire claim for existence upon purely educational grounds.

That botany has a definite practical field aside from distinguishing deadly from edible mushrooms, or being able to tell poison ivy when you see it, is usually something entirely new to that most impractical of persons, the so-called practical man, and the assertion that years spent in looking through the microscope or in the scientific investigation of problems concerning plants could ever add to the world's wealth or be classed as a productive pursuit, is often quite beyond his comprehension. Because botanists generally want the interest of this class of men, would like their advice occasionally, and under all circumstances need their money, it is well perhaps that now and then the utilitarian side of the study of plants be emphasized, even though it may shock a few of those who seem to have associated themselves with the profession because they consider it so absolutely incapable of being turned to account. For it must be confessed that there still persists a small class of botanists who look upon anything practical connected with the subject in much the same way that a physician regards advertising. Just why it should be a disgrace to undertake a problem which has a definite industrial application is a little difficult to understand, but there can be no question that some investigators need no further inducement to drop a piece of work than to have it intimated that possibly it may result in some good. It is to such members of the profession that we owe, in part, at least, the comparatively low place botany takes to-day as one of the applied sciences.

It is also true that the indifference of many of the earlier botanists to those problems, the solution of which promised to be of actual service to mankind, has made it necessary for other more enterprising scientists to undertake work not strictly within their province and has resulted in the credit accruing to their particular field rather than to botany, where it belonged. It is a fact to be regretted, but which can not be denied, that systematic botany so occupied the attention of the early students of plants that it was necessary for physicians and chemists to make nearly all the investigations carried on in plant physiology and similar branches of the subject. This naturally led many to consider that there was nothing to botany except the analyzing of flowers and recording their names, and although this branch of the subject contributed its share to the establishment of applied botany, it was not sufficient of itself to bring the profession to the high position it deserves as an industrial science. Even now the old order of things is so strong upon some of us that there still exists a kind of feeling that any investigation carried on with plants, other than their systematic determination, is not pure botany and should be relegated to the chemist or physicist. While this is unfortunate, it is not of so much consequence as at one time. Such a condition, however, tends to prevent a proper estimate of the value of our science in comparison with others, and makes it possible for such statements as the following, recently made in a public address, to go unchallenged: "Practically all forms of productive activity from the cultivation of the soil for the growth of cotton to the finished tinted fabric, from the digging of the ore to the engines which distribute our commerce in its most varied ramifications, rest upon chemical phenomena." I think it is about time for the botanist to begin to assert himself, at least to demonstrate by his work and the results obtained that botany has fully as large a place in productive activity as any of the other sciences, and that much more credit is due to the student of plants than is ordinarily supposed.

Another reason why botany has not taken first rank among the applied sciences is that when investigation has shown the study of certain plants to be of vast economic value, the results have been of such importance that that particular line of work has soon assumed the proportions of an independent science, and consequently the parent has often been lost sight of in the admiration for the child. I imagine the members of the Society of American Bacteriologists would be somewhat surprised if they were asked or expected to merge with other botanical societies and form a section in any large botanical organization. And yet this is the only logical place for them, and in the time of Cohn and DeBary there would have been no question about it had the bacteria been considered of sufficient importance to warrant a separate section. It will not be long, if indeed the time has not already arrived, when forestry will cease to give any credit to botany for the practical results being obtained by this rapidly developing profession, and other examples might be given to illustrate the general tendency to magnify the industrial branch of a science at the expense of the main body from which it originally, at least, obtained its strength.

Part of this diversification in botany is due to the fact, of course, that as a science it does not involve certain methods as in the case of chemistry or physics. It is usually a simple matter for the average person to recognize the benefits derived from either of the two last-named sciences, because they are definitely associated with test tubes and balances, reagents and dynamos, and other well-known objects.

This recognition of the method is carried to such an extent as to result, in university catalogues at least, in such hybrids as 'chemical-engineering,' 'chemical-mineralogy,' 'mathematical-geology,' 'mathematical-biology,' etc. An investigation into what is usually taught under such heads shows that it would be fully as legitimate to establish courses in botanical-architecture because of the knowledge of woods required, or zoological-engineering since the power is reckoned in horses. As well try to assign all work involving retorts and reagents to chemistry, to call everything botany or zoology which requires the use of a microscope, or claim for physics the exclusive privilege of developing all industry involving light or heat or motion, as to maintain that because a method originated in one science it can not be applied in another without uniting the two, or even losing the problem involved in the contemplation of the tools to be used in solving it. There are certain definite lines of research which appear to all fair-minded investigators as belonging to certain fields. The question to be answered is either chemical, zoological, botanical or whatever the case may be. A dozen sciences may contribute to its solution, but the fact should always stand out preeminently as to its real origin. This has not always been the case in botanical problems, and it may be a matter of some time before workers in general recognize this principle. Nevertheless, I think it extremely necessary that botanists do not fail to call attention to such cases and that in the future no opportunity be lost to obtain all proper and legitimate credit for our science and profession. The time for modestly sitting in the background and seeing our best fields for work appropriated by other sciences should have passed.

It may seem as though I were a long time coming to the second part of my subject, but the ignorance regarding the industrial importance of botany, as compared with the other applied sciences, seems to call for some explanation, and I have sought to point out, very imperfectly I will admit, a few of the reasons which have occurred to me as accounting for this peculiar situation.

To attempt to give even an outline of the many botanical achievements which have been of economic importance is manifestly impossible in the time at my disposal. Neither is it necessary to submit a catalogue of the work accomplished by those most eminent in our profession.

I do think, however, that any evidence calculated to enhance the importance of pure investigation (that most necessary source of practical results in botany) should be referred to frequently, because there is no use in attempting to conceal the fact that the average man of the world looks with contempt upon the general subject of scientific research as undertaken in botany and similar fields. That certain so-called scientific investigations carried on in the name of research are far from being in any way a contribution to science must be admitted; but so much good work is being done that it is time that we make a little more of an effort to have it receive proper recognition. Perhaps the day will come when research work will appeal to the world upon its merit. Certainly the last ten or fifteen years have seen a great advance in this line, but at present there is no question but that the best and quickest way to obtain the recognition and reward due to pure botanical research is to show how practical results are obtained by this means, which years of blind groping along applied lines have failed to produce.

If I may be allowed to take an example or two from my own experience, I will refer to the investigations leading up to the solution of the problem involving the prevention of bad odors and tastes in drinking water. This disagreeable effect, due to the growth of algæ, has been one which has baffled the efforts of engineers, chemists and bacteriologists for years. And well it might, for why should a question of this kind, involving the life history of a certain small group of cryptogamic plants, be referred to any other profession than botany for its answer?

There is not a state in the union which has not reported difficulty from these algal growths, and in some communities the odor and taste during certain months of the year have rendered the water absolutely unfit for use. In a few cases the strong odor has even necessitated the giving up of the use of the water for sprinkling the streets and lawns. One water commission in New England considered the trouble due to algæ of so much importance that they were willing to expend about four million dollars upon devices, by no means certainly effective, in order to try and prevent such difficulties. A city in the far west spent over one million dollars securing new sources of supply so that the algal-polluted reservoirs might be abandoned. In the south we have a case where the algæ led the local authorities to take steps to cause the franchise of the water company to be forfeited, on the ground that they were not furnishing a potable water. The company had spent thousands of dollars in mechanical filters and other devices, without results, and there was no alternative but to install a new supply at a cost of double the one already in use. There is no necessity for multiplying examples. Those of you who are familiar with the question of furnishing pure water in this country know how many millions of dollars have been lost owing to the presence of algæ in water, to say nothing of the great inconvenience caused by the odor and taste and for which there did not exist an adequate remedy. It is needless to say that a question of so much financial importance has been investigated exhaustively from the so-called practical side, and various recommendations made, all of little or no effect. Finally, the difficulty was relegated to the botanists, who took hold of the problem from the purely scientific standpoint and showed how certain plants were the specific cause of the trouble. It was then a comparatively simple matter, by applying the knowledge gained years ago by Naegeli and others in botanical research, to find a remedy for the difficulty. The only wonder is that it was not thought of before. Within the last six months the method of destroying or preventing the growth of algæ in water supplies, as devised by the Department of Agriculture, has been used with marked success in over fifty water supplies throughout the country, on a scale running into the hundreds of millions of gallons, and causing a saving in money difficult to estimate. In fact, there is now on file a list of testimonials from hard-headed, practical, business men which should make systematic algology and plant physiology hold up their heads with pride. The whole matter has created a demand for trained botanists able to tell the difference between *Volvox* and *Uroglena*, which can not be supplied, and there is no doubt but that within the next few years the leading water companies will consider an algologist as important a member of their staff as the bacteriologist, and under certain conditions, of much more practical necessity than a chemist. It is difficult to prophesy what will be the future of this method which applies our knowledge of plant physiology in such a simple manner. Physicians and health officers are making use, in a number of different ways, of this piece of botanical investigation, and the employment of copper in one form or another, as an efficient means of fighting typhoid, cholera and similar diseases is undoubtedly destined to become of the utmost importance. I have referred somewhat in detail to this example because it seems to me to offer a very strong argument in favor of the ability of scientific research to furnish the solution for some problems which ordinarily might not be considered as falling under its influence. Here we have a long history of failure, due to the lack of scientific information. I am sure no one can realize how complete and absolute that failure has been until he has had an opportunity of examining the reports made by the practical men who have been attempting to solve the difficulty. It is no wonder that it was not until the investigation was transferred from the reservoir to the laboratory that the remedy was found.

Perhaps no branch of botanical research seems farther removed from the practical side of life than that usually referred to as cytology. The killing and fixing, staining and cutting of plant and animal tissue, seem to be an operation calculated to result in but small good to mankind, however much it may add to its store of information. But it is not beyond the range of possibility that these very cytological investigations of Farmer and other botanists may be destined to throw much light upon what may be termed the most important unsolved problem in medicine. Most of the diseases in the world are the result of filth, or imprudence, or some condition which could be prevented if we would. Tuberculosis, diphtheria, typhoid fever and similar contagious forms can generally be prevented and are most certainly curable, if we but use the knowledge that scientific research has given us. But cancer remains as the one dread disease, about which authorities are in dispute even as to its origin. Ask any up-to-date physician, thoroughly familiar with the results of research in laboratories at home and abroad, what is the most baffling, the most hopeless disease, the one thing he oftenest meets for which he has no remedy, and there will be no hesitation in his reply of cancer. That the cytological investigations of Farmer and others, concerning the abnormal growths occurring on ferns, may lead to the ultimate solution of the cause and cure for cancer, we can only hope; but certainly they have been able to throw a flood of new light upon the nature of malignant growths in man which can not but be of practical value.

The application of facts obtained from pure research in that most practical line of botany—plant breeding—is well known to all of you. Of the utmost theoretical importance, this branch of botanical investigation makes it possible to increase the yield of wheat and corn a definite measurable number of bushels which the farmer can appreciate at once. It is useless to enumerate the fruits, grains, fibers, etc., that have been improved by this means. It has been said that in the breeding of plants we have a practise unconsciously carried on for centuries, and that the ordinary selection of the farmer results in as great improvement as can be obtained from the application of scientific knowledge as to the strains best adapted for crossing and selecting. If this be true, why is it that all these centuries have not given rise to the results, easily obtained in one generation by the scientific way? No one would for a moment wish to dispute the great good that has resulted from the use of the knowledge gained from experience in the raising of plants for commercial purposes, but when one has witnessed the immediate benefit of the application of science to the traditional practises of the farmer and horticulturist, he can no longer deny that the combination is more practical and more efficient, and results in returns vastly in excess of those obtained when the methods are separated by prejudice or ignorance.

It is always easier to estimate the value of any piece of work when it is possible to base it upon what has been actually gained, rather than upon any loss which it prevents. Consequently, the vast saving to this country because of the investigations made upon plant diseases is usually overlooked. No line of botanical research has resulted in a greater practical benefit to the farmer and those engaged in the growing of plants for profit, and yet it is seldom that the tedious and necessary investigations carried on by the mycologist, upon which all intelligent remedial work is based, receive due credit.

If we turn to the realm of beneficial bacteriology and mycology, there are, of course, innumerable instances of the direct results obtained from botanical research, not only in those processes having to do with the growing of crops for man and beast, but also in increasing the value and importance of numerous industries. See how necessary the trained mycologist has become to the brewer! No industry is more scientific in its methods, and it required but the investigations of Hansen and Jörgensen to place the business upon a plane of absolute security, scarcely enjoyed by a manufacturer depending upon the most mechanical and routine processes. By the pure yeast cultures the brewer has everything under his control, for the mash is sterilized by boiling and the addition of the hops prevents the growth of deleterious bacteria which might be added subsequently. Thus, there is no reason why the beer made a year hence should not be precisely the same as that made to-day.

The maker of wine has not been so quick to take advantage of the information furnished by botanical research, and in many cases the results of his labors are lost, or at most, the product is often far from what it might have been had the proper plant furnishing the proper enzyme been specifically added, instead of its being left to chance. While it is true that there may be difficulties attending the sterilization of the grape must, which, of course, is laden with wild yeasts and moulds, to say nothing of the bacteria, it seems more than probable that by proper attention to the acidity of the must and by adding the pure yeast in considerable quantity so as to overcome the objectionable forms, most beneficial results may be obtained. Certainly, the only way in which the making of wine is to be placed upon the same precise and satisfactory basis as that of malt liquors, is by investigations concerning the purely scientific processes involved and not by a continuation of the old hit-or-miss, inaccurate methods developed centuries ago before there existed any botanical research.

It is not necessary to refer here at length to the wide influence research has had upon the dairy industry. Slow as we are to abandon long-established custom, the introduction of the pure 'starter' for the production of a standard type of butter is coming more and more into use, and the certainty with which it is now possible to obtain an agreeable and pleasant aroma in butter, with no danger of spoiling the product, is what has made possible the vast creameries of the present day.

While it is probable that the part played by bacteria is not so important in the ripening of cheese as formerly supposed, the necessity for the lactic bacteria in acidifying the milk for the production of a good curd is well recognized. We also know that in some kinds of cheese moulds are essential to produce the characteristic flavor so much relished by some. In addition, the supplying of certain bacteria, known as 'langvey' in Holland, plays a most important part in preventing the deterioration of the cheese, owing probably to these organisms keeping down the growth of objectionable forms by exhausting certain necessary food products. This latest discovery is likely to open up a new field in the dairy industry, as, in a sense, it does away with the necessity of keeping out all deleterious organisms, and permits a good product under conditions which otherwise would make it impossible to manufacture cheese at all.

The debt owed by the tiller of the soil to the vast number of purely botanical investigations of so much money value to the farmer, is but seldom recognized or acknowledged. To admit oneself a scientific farmer is to at once invite a deluge of almanac and comic weekly jokes that have been accumulating against this class since Adam began to work for his living. And yet, barring conditions beyond the control of man, the only way in which the most profit can ever be obtained from a farm is by adhering rigidly to the information based on pure science, much of which has been discovered in the botanical laboratory. It is quite true that certain wild speculations, masquerading as scientific research, have resulted in unjustly causing many practical men to look upon botanical investigation as being the last thing to prove beneficial to those who grow plants for profit. But the farmer is beginning to distinguish between the real and the false, and it will not be long until it is recognized that the only man who fails to make a success out of his land is the unscientific one, who either can not or will not take advantage of the practical facts put at his command by the investigator in the laboratory, who may not know the difference between a double shovel and a disc harrow.

It is also interesting to note that our science can no longer be disregarded by the judge and the lawyer as being without their sphere, for it has been possible for the botanist to invade the field of expert testimony in a most practical fashion, and the number of cases demanding the knowledge which can only be properly furnished by a student of plants are constantly multiplying. In one instance, an increase from $9,000 to $25,000 in the damages asked, was due directly to the evidence submitted, depending entirely upon plant histology and physiology. And the basis upon which a verdict of $20,000 and costs was finally rendered was the possibility of demonstrating damage by the discussion of such strictly botanical subjects as cross-sections of rose leaves, cambium, photosynthesis, root pressure, etc. That the result would have been different had the attorney for the defendant possessed a little botanical knowledge is perhaps a question, but there is no doubt but that his examination and cross-examination were sadly confused for the want of a few correct ideas about plants.

After all, it is not so important to dwell upon what scientific research has done in the past for practical botany and related subjects, as to emphasize what it may do in the future. Fortunately, botany is not yet at the place where she desires to stop and contemplate her achievements in a spirit of self-satisfaction or contentment. The unsolved or uncompleted problems of the industrial world waiting for help from the botanists are many, even more, perhaps, than the botanist himself realizes. No one man could enumerate them and any attempt to more than suggest the opportunities in a few lines with which I am most familiar would be presumptuous. Therefore, I hope it will be understood that my idea in mentioning the possibilities of scientific investigation in one or two specific cases is not intended as an indication of what I myself may hope to accomplish in this way, or as suggestions to others who are engaged in more important work. I merely wish to indicate to those not familiar with botanical research how we realize that much remains for us to do.

To begin with a very homely example, the investigation of the bread yeasts offers a fertile field for some botanist desiring to be of service to his fellow-man by improving one of the most necessary and important manufacturing processes carried on in domestic life. An examination of many of the yeast cakes upon the market will show that they usually are as rich in bacteria as in yeast cells, no particular care having been taken to maintain the purity of the yeast. While we have had some investigations pointing out the bad effect of certain of these bacteria upon the bread sponge, it is more than likely that other bacteria may be of great importance in converting the starch to sugar; at any rate, definite scientific knowledge is necessary before we can hope to get the best practical result. The possibility of improving the bread yeast itself is also a piece of work which I am not aware has yet been undertaken. When it is remembered that the source of most bread yeast is a beer yeast and the function of the two is not by any means the same, it would appear that some careful cultural work would be calculated to greatly improve the ease and certainty with which good bread might be made. Another possible point of improvement lies in the fact that the bread yeasts on the market are generally selected because of their rapidity of multiplication. Since it is now known that this function generally varies inversely as the gas forming power, it would seem more than likely that by no means the most efficient type of yeast was now being used for bread-making purposes.

Tanning, flax and hemp retting, and other similar industries dependent upon fermentations set up by various micro-organisms, all offer most inviting possibilities for the utilization of the results of pure botanical research. Because certain operations, worked out by experience and many failures, have been carried on for centuries with a fair measure of success, is no argument against the scientific investigation of the fundamental processes underlying the results obtained. It is more than probable that by the discovery of the precise organism involved, and the elimination of the undesirable, if not harmful, forms introduced accidentally, certain industries in this country can be revived and put upon a paying basis undreamed of by the practical man. At any rate, if improvement is to come, it must be as the result of information acquired by means of the scientist working in his laboratory, rather than through the efforts of the business man and manufacturer in the shop.

The possibility of large practical results from botanical investigations along agricultural lines seems to be particularly promising at the present time, probably because so many botanists are directing their attention in this direction. What the future has in store for the farmer of this country, because of the researches now being carried on in plant pathology, plant physiology, soil bacteriology and other branches of botany, can only be conjectured, but that much of real value will be forthcoming there can be little doubt. In no other field are the opportunities so great; in no other way are the practical returns of botanical investigation so sure.

When the farmer is made to realize that the soil upon which he is so dependent is not dead and inert, but a living, changing thing, the laboratory in which some of nature's most wonderful miracles are performed, he will be more ready to accept help and advice from a man who may not know how to plant and reap, but who understands the nature of the growing and the fruiting and the factors controlling them, as only one who has given himself to searching for botanical truths can know them. And when such knowledge applied by the farmer means all the difference between success and failure, an increase of one hundred to one thousand per cent. in his crops, the growing of new plants in new ways, the successful combating of ruinous diseases, the conservation of the real worth in the manure pile instead of allowing all its fertilizing power to be wasted into the air—these and many other practical results will at no distant day establish botanical research as one of the most necessary and beneficial aids to the most important industry in the world.

Before I conclude, it may be well, perhaps, to inquire into the nature of the research now being carried on in botany under the name of scientific investigation. Is it always scientific, or, indeed, even botanical? Does it in every case result, not necessarily in creating value where waste and worthlessness existed, but in that real addition to knowledge and the clarification of the subject which is supposed to be its function? I am sure you will agree with me that nothing so tends to prevent the advance of any science as for it to be loaded down with a vast weight of undigested facts, which are published and republished by man after man in the fond belief that they are 'contributions to knowledge.' Such a practise can not always be prevented, but it behooves botanists to realize their responsibility and to do all in their power to elevate their science and the character of the work being done under their direction. It does not necessarily follow that because a man has just taken his bachelor's degree that he is qualified to carry on the investigation of some real problem in botany, even though his instructor does give him the subject. Far be it from me to advocate in any sense of the word a commercial test for botanical investigation. There are many problems in botany which all of us want answered, but which probably will never be capable of an industrial application, and no one wants them to be. Furthermore, it is not given to us to determine the outcome of any particular line of work, and those fields which have seemed furthest removed from utility have often yielded results the most beneficial. I do wish, however, that the test always applied to scientific work which has a practical application might also be used, at times, at least, in judging all botanical investigation. There can be little doubt about the wide difference in the scrutiny given a paper prepared on some technical subject, upon which the writer is no doubt able to speak with authority, but which will at most provoke a controversy between some half dozen others in the world who are likewise authorities, or think they are, upon the same subject; and in promulgating a theory or a method of economic value which will be tried by thousands with no regard for your feelings, if it fails to accomplish all you have claimed for it.

If this proving of our botanical work, by the rules and regulations of a practical world, accomplished nothing else, it would certainly tend to make the general character of scientific investigation a little more exact and definite than it has always been in the past. A clock striking the half hours near midnight does not always give the information you wish. It may be half-past twelve, or one, or half-past one, and in spite of the number of times it makes itself heard it is of no more value and not nearly so satisfactory as a clock not striking so often, but telling the time when it does strike. We make many claims for the high ground upon which scientific research stands, but I am inclined to think that the motive behind part, at least, of the botanical investigation of this country is no further removed from criticism than if it were undertaken for the mere dollars and cents involved in a commercial proposition. It is a fine point in ethics to determine whether the reward of a degree, a fellowship, or a teaching position for a piece of scientific research, places the work and the worker upon a higher plane than when similar investigations are undertaken for the purpose of solving a problem of definite money value which, unfortunately, for this reason alone are apt to be more accurate and more complete.

And here I think it may not be out of place to felicitate those who have been so instrumental in building up the *true* botanical research of this country (and those who have had the good fortune of being under their instruction are also to be congratulated), upon the very high place Americans have come to occupy among the botanists of the world.

Not long ago, while visiting the laboratory of a noted German botanist, I asked if he had any American students. "No," he said, "I do not expect to have any more. There is no need for you Americans to come to Germany any longer. You have the men and the laboratories. One needs only to come to Europe for the language or to look at specimens." Is it not time that the botanists of this country began to let it be known that even the Germans are recognizing our worth and our facilities, and that when a student goes abroad it is no longer because no one in this country is capable of teaching him, but for the language, the experience, the travel? Indeed, if it did not sound too vain-glorious, I would have no hesitation in saying that, in certain lines, at least, we have so far exceeded the foreign teachers and laboratories that it can not be long until the tide turns in the other direction and the most anti-American botanist will be forced to come to us for information.

The day is easily within the memory of some men now teaching chemistry, when this science had no more standing as an economic subject than botany has now. I believe, if botanists but realize the necessity of calling the attention of the world to the practical results already accomplished, and will maintain the standard of true scientific research at its highest point, that botany will very soon take the foremost place among the applied sciences. Further, I am of the opinion that the uniting of *all* those professionally engaged in the study of plants into *one* efficient, active organization could not but hasten this day, and that it would not be long until chairs of applied or industrial botany would be as necessary in a thoroughly equipped university as they are now considered for certain other sciences. We have scarcely more than begun the scientific investigation of a field which offers the widest opportunities for results. Not only does it seem probable that practically new lines of business are to be created by botany, but the improvement in old methods which have been maintained for centuries simply because 'our fathers' did that way, has already demonstrated to the most conservative that the scientific botanist, true to type, is a man of immense practical value to the farmer, the manufacturer, the engineer and the world at large.

May we none of us, by our work or our words, retard the rapid advance now being made, along both pure and practical scientific lines, of our chosen science—botany.

George T. Moore.

Bureau of Plant Industry.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION B, PHYSICS.

The annual meeting of Section B, Physics, of the American Association for the Advancement of Science, in affiliation with the American Physical Society, was held in Philadelphia on December 28, 29 and 30, 1904. The attendance was representative in an unusual degree of the physicists of the entire country, including not only those from many important institutions of the east, but also from the south, the west, and from California. The average attendance was nearly one hundred.

The retiring vice-president, Edwin H. Hall, introduced the presiding officer, Professor W. F. Magie, of Princeton University, the vice-president of Section B. The other officers of the section who were in attendance were Dayton C. Miller, secretary; Henry Crew, councillor; A. W. Goodspeed, member of the general committee; and the following members of the sectional committee, W. F. Magie, E. H. Hall, D. C. Miller, E. L. Nichols, F. E. Nipher, G. F. Hull, A. G. Webster, D. B. Brace.

For the next meeting, to be held in New Orleans, beginning December 29, 1905, the presiding vice-president is Professor Henry Crew, of Northwestern University. The other officers for the New Orleans meeting, so far as now determined, are:

Retiring Vice-President—W. F. Magie.

Members of the Sectional Committee—Henry Crew, W. F. Magie, D. C. Miller, E. L. Nichols, F. E. Nipher, G. F. Hull and A. G. Webster.

Secretary—Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

On Thursday the retiring vice-president, Professor E. H. Hall, of Harvard University, gave an address on 'A Tentative Theory of Thermoelectric Action.' This important paper, which is printed in full otherwhere in this journal, was listened to by an unusually large audience.

Twenty-two papers were read before Section B, all of which were of such importance that it was generally expressed that this meeting was one of the most valuable that Section B has ever enjoyed. The subjects may be classified as follows: on light, nine papers; on electricity, five; on meteorology, two; and on general subjects, six papers. Papers on related subjects were grouped together more than had been usual before, and ample time was allowed for discussion. This arrangement added to the value, as well as to the enjoyment, of the sessions.

Beginning on Friday, December 30, the sessions were in charge of the American Physical Society; a large number of valuable papers were read, an account of which is given in the report of the Physical Society.

The abstracts of the papers read before Section B are given below.

Note on the Mirror-Telescope-Scale Method: George F. Stradling, Manual Training School, Philadelphia.

Let a ray of light of fixed direction fall upon a mirror turning about a vertical axis. The reflected ray is received upon a plane. If the incident ray passes through the vertical axis, and this axis lies in the plane of the mirror, and the plane on which the reflected ray falls is parallel to the mirror-plane, the curve traced by the spot of light as the mirror turns is a hyperbola. Discussion of another case.

Some Convenient Laboratory Apparatus: Horace C. Richards, University of Pennsylvania.

I. *An Apparatus for Quickly Washing and Filling Vessels with Small Openings.*—It consists of a small glass cylinder mounted on a suitable stand and provided with three outlets, one leading to the vessel which is to be filled, one to that containing the liquid, and the third to an aspirator through a trap. The liquid is first drawn up into the cylinder and then, by intermittent working of the aspirator, is driven into the vessel. A similar process empties the vessel and carries the liquid over into the trap. For mercury, etc., the form is slightly modified so as to prevent loss of the liquid.

II. *A Simple Automatic Mercury Washer.*—Mercury is raised by an aspirator into a vessel placed above a vertical tube filled with dilute nitric acid. When the vessel is filled, the aspirator is automatically shut off and at the same time air is admitted by a pair of valves operated by a float. The mercury then filters through a small valve in the bottom of the vessel and falls in small drops through the column of acid. It is then returned to the reservoir from which it was drawn and so is passed around through the acid as often as is desired, the aspirator being set in action again when the upper vessel is nearly empty.

The Double Suspension Pendulum for Determining the Absolute Value of the Acceleration of Gravity: R. S. Woodward, Carnegie Institution.

This paper describes an apparatus specially designed to avoid the difficulties presented by knife-edge pendulums and to secure a degree of precision in absolute measures of the acceleration gravity comparable with the precision already attained in relative measures.

Heat Insulation of Observatory Domes, Laboratories and Other Buildings. David Todd, Amherst College.

To prevent excessive heat accumulation in the new observatory domes at Amherst waste granulated cork is put in between the interior galvanized iron sheathing and the exterior wood boarding on which the copper roof is fastened. One and one half to two inches of cork is sufficient to keep interior iron always cool to the touch, no matter how hot the copper gets when the sun is shining normally upon it. Mineral wool would be nearer fire-proof and equally good insulation, but adds more weight. Numerical tests will be submitted.

The Relation Between Air Pressure and Velocity. Francis E. Nipher, Washington University. To be published in the *Transactions* of the Academy of Science of St. Louis.

The paper describes a method of determining the constant in the equation $P = kv^2$ when the air blows into the open end of a tube collector. The tube was bolted to a small pulley on a shaft which could be run at various speeds. The open end was 36 inches from the center of the pulley, and the plane of the opening could be set at any angle with the circular path which it describes. When at right angles to the path the air within the tube is found to be in equilibrium during rotation. The pressure required to balance the outward radial tendency is equal to the pressure due to the wind at the open end of the tube. When this condition is imposed in the equation the value of k is obtained in terms of temperature, barometric pressure and velocity. The value is practically independent of v for velocities less than 100 miles per hour.

The Temperature and Drift of the Air at Great Heights above the American Continent, Obtained by Means of Registration Balloons. (Preliminary Report.) A. LAWRENCE ROTCH, Director of Blue Hill Meteorological Observatory.

Although the meteorological conditions of the lower two or three miles of air have been investigated by means of kites at Blue Hill Observatory during the past ten years, no observations have been made at greater heights in this country. Through cooperation with the management of the St. Louis Exposition, the author obtained such observations by means of ballons-sondes; fourteen of these balloons carrying self-recording instruments were despatched from St. Louis and all were recovered with ten records of barometric pressure and air temperature. From the barometric records the maximum height attained was found to be about 51,000 feet, where the temperature was 68° F. below zero on September 23. At a height of about 45,500 feet (the maximum of the second series of experiments) the temperature was —72° F. on December 2, the lowest temperature, —76°, occurring at a height of about 33,000 feet on November 26. The direction and velocity of the upper air currents were indicated approximately by the places and times at which the balloons fell. The velocity twice exceeded 100 miles an hour and all the balloons (excepting one which did not rise out of the surface current) drifted towards the east, in general diverging from the areas of low barometric pressure at the ground.

An account of these experiments will be published in full in the *Annals of the Harvard College Observatory,* Vol. LVIII., Part II.

Optical Refraction in the Lower Atmospheric Strata, as Affected by the Meteorological Conditions. (Preliminary Report.) A. LAWRENCE ROTCH, Director of Blue Hill Meteorological Observatory.

The variation in refraction has generally been attributed to the differences in the temperature of superposed strata of air, but there have been few investigations upon the effect of the daily changes in meteorological conditions. Accordingly, during two years, observations were made three times a day with a precise level, on the summit of Blue Hill, of the apparent angular depression of a lighthouse in Boston harbor, fourteen miles distant and 550 feet below the hill, the temperatures here and over the water being known. Since the temperature of the air over the ocean is more uniform than that over the land, there is a large annual period in their difference, but no relation between these vertical gradients and the observed refraction is evident, nor do the monthly extremes appear to be connected with the corresponding gradients of temperature. This indicates that there are other controlling influences and these are now being sought. The investigation will be published in Vol. LVIII., Part II., of the *Annals of Harvard College Observatory.*

Experimental Study of the Use of Weston Instruments for Ballistic Magnetic Testing. ALBERT F. GANZ, Stevens Institute of Technology.

At various times it has been either claimed or disputed that a damped galvanometer in which the damping force is proportional to the velocity of the moving system may be used for ballistic magnetic testing. In the *Physical Review*, of March, 1903, there is an article by O. M. Stewart in which it is shown mathematically that such a damped galvanometer conforms to the ordinary law of the undamped ballistic galvanometer. It is also stated in this article that an ordinary Weston ammeter without its shunt or a Weston voltmeter without its series resistance may be used for determining permeability and hysteresis curves by the ballistic method.

The experiments to be described in this paper were undertaken last spring by two senior students, Mr. E. E. Greve and Mr. A. R. Barkus, under the direction of the writer, for the purpose of comparing the permeability and hysteresis curves obtained by means of ordinary Weston instruments, with the curves obtained by means of a slow-period undamped ballistic galvanometer. It was found that the curves for a laminated iron ring obtained with an ordinary Weston instrument fell about three per cent. below the curve obtained with the ballistic galvanometer. It was also found that the permeability curve for a solid iron ring (cross-section 1 sq. in. mean diam. 7 in.) obtained with an ordinary Weston instrument fell over ten per cent. below the curve obtained with the ballistic galvanometer. The cause of this falling below is undoubtedly that the time of the first swing of the ordinary Weston instrument is too short to take account of all the change in the magnetic flux which occurs. The Weston Instrument Co. then constructed a special instrument having a greater moment of inertia and more magnetic damping than their ordinary instruments, and having, therefore, also a much longer time for its first swing. This new instrument was found to give a permeability curve for the laminated ring which agreed exactly with the curve obtained with the ballistic galvanometer. For the solid ring the permeability curve was still, however, several per cent. below the curve obtained with the ballistic galvanometer. In order to make a direct reading magnetic flux meter out of this instrument ten yards of flexible cord were taken to be used for a secondary coil, and a resistance was added to the instrument, and this was adjusted so that the instrument would indicate the flux in kilomaxwells changed per turn using this secondary. This instrument was, therefore, called a 'Weston Maxwell meter.' This Maxwell meter has been considerably used in the laboratory of Stevens Institute for obtaining magnetization curves, measuring leakage coefficients, etc., and has been found extremely useful. The Weston Co. are now constructing a second special instrument having a still slower period, which is expected to give accurate results as well for solid iron samples as for laminated ones, and this will be a direct reading, portable and permanent Maxwell meter having a uniform scale, which will be generally useful for all kinds of magnetic testing and which can be used directly without previous calibration. Owing to the slow period of these special instruments the extent of their first throws can be very accurately noted.

Measurement of the Thompson Thermoelectric Effect in Iron. Edwin H. Hall, Harvard University.

Description and Demonstration of the Poulsen Telegraphone. Z. B. Babbitt, New York; Introduced by Arthur W. Goodspeed.

The principles involved in the Poulsen telegraphone and the practical construction of the apparatus were explained. The reproduction of human speech was then demonstrated.

Circular Dichroism in Natural Rotary Solutions. D. B. Brace and W. P. McDowell, University of Nebraska.

Electric Double Refraction in Liquids Under Low Electric Stresses, and also at the Boiling Point. D. B. Brace, G. W. Elmen and L. B. Morse, University of Nebraska.

The Electromagnetic Theory and the Velocity of Light. Henry T. Eddy, University of Minnesota. (To be published in the *Physical Review.*)

Mr. Mills has recently published a paper* in which he has given the results of measurements made by him of the increase in the velocity of circularly polarized light in bisulphide of carbon along the lines of force in a magnetic field. Employing circularly polarized light, he was successful in obtaining a difference of one or more wave-lengths between two rays circularly polarized in opposite senses, one ray having its velocity increased while the other was decreased, and this was obtained with apparatus with which no difference whatever was observable in case of plain polarized rays.

The apparatus mentioned is a form of interferometer devised by Professor Morley and paid for by a grant made by the American Association for the Advancement of Science for the purpose of investigating certain points to which the present writer had taken exception in the theory of the Faraday effect as developed by Professor Rowland,† who had attempted to account for the twisting of the plane of polarization of plane polarized light while being propagated along the lines of force in a magnetically active medium by the action of the Hall effect in the medium. As just stated, the present writer found himself unable to agree with that part of Professor Rowland's most valuable theoretical treatment of the Hall effect which related to rotary polarization. After a full presentation of the theoretical questions involved at the Toronto meeting of the American Association for the Advancement of Science, in 1889, the apparatus was constructed, and after many delays a final report was presented to the American Association for the Advancement of Science, at the Boston meeting, August, 1898. The report was duly published* and contains, first, the present writer's theoretical developments and computations as to the possible increase or decrease in velocity to be looked for in case of magnetic twisting of the plane of polarization, and second, a full description by Professor Morley of his apparatus and a detailed account of the experimental work by Professors Morley and Miller, who worked in collaboration. No experimental change in the velocity of plane polarized light could be detected with this apparatus, and the numerical computations just mentioned showed in fact the possible change in the velocity to be too minute to be detected by the apparatus as used. Although such is the fact with plane polarized light, the experiments of Mr. Mills show that such is not the fact with circularly polarized light. Moreover, it will be shown theoretically that in case of circularly polarized light the amount of change in velocity due to the magnetic field is expressible as a lower power of small quantities, than in case of plane polarized light, and consequently the magnitude of the change in the former case is large compared with the latter, and in fact varies as the square of the latter; and while the latter may be quite beyond the range of observation, the former may be well within it, as the experiments of Mr. Mills have proven.

In view of this it is the aim of this paper

* *Phys. Rev.*, Vol. XVIII., p. 65, Feb., 1904.

† *Am. Jour. Math.*, Vol. 3, p. 109, 1880.

* *Phys. Rev.*, Vol. VII., p. 282, December, 1898.

in the first place to rediscuss the questions at issue and point out more in detail than heretofore how, according to elementary theory, the velocities of plane and circularly polarized rays in any optically or magnetically active medium must be necessarily related to each other, and how, according to elementary theory, it is impossible that Professor Rowland's equations can represent a twisted plane polarized ray.

In the second place, it will be shown how these velocities in the magnetically active field are related to the velocity in zero field according to the several proposed hypotheses. Were it possible to make this comparison experimentally, we should have a test as to the validity of the proposed hypotheses, but such test is as yet beyond reach by reason of the smallness of their differences.

An attempt is made, in the third place, to show that a moderate degree of absorption would exert a negligible influence in modifying the results already developed for perfectly transparent media.

The conclusions arrived at in this paper may be briefly stated as follows:

1. The increase or decrease in the velocity of circularly polarized light observed by Mr. Mills, and previously by Professor Brace, are perfectly in accord with and a necessary consequence of the elementary trigonometrical equations expressing the propagation of twisted plane polarized light, and the phenomenon is independent of any hypothesis, electromagnetic or otherwise, as to the manner in which the twisting is produced.

2. The equations given by Professor Rowland to express the propagation of twisted plane polarized light are not suitable for that purpose, for they in fact express the propagation of a uniformly and continuously rotated plane polarized ray, such as is at present unknown to experimental physics.

3. The velocity of a twisted plane polarized ray is so related to the velocities of the right and left circularly polarized rays of which it is composed that its reciprocal is the arithmetical means of the reciprocals of its components; and the velocity of Professor Rowland's rotating plane ray is the arithmetical mean of the velocities of its right and left circularly polarized components.

4. The differential equation based on two different electromagnetic hypotheses as to the action of the medium in producing rotation or twisting of plane polarized light in a magnetic field involves an equation expressing the relation of the velocity of this kind of light at zero field to its velocity in the given field. On the hypothesis of orbital motions of charged ions the differential equations show that the field would cause a decrease in the velocity of plane polarized light during the twisting; while on the hypothesis of charged ions having a motion of translation across the field, the differential equations show that the field would cause an increase in the velocity by an amount one-third as great as the decrease just mentioned. This increase or decrease is of the second order of small quantities, and is so minute as to be at present beyond the range of observation, varying as it does as the square of the observed change produced by the field in the velocity of circularly polarized rays.

5. MacCulloch's differential equations involve practically the same decrease of velocity by the medium as those based on orbital motions of charged ions.

6. A moderate amount of absorption in the medium would not practically modify the conclusions true for perfectly transparent media on either hypothesis.

On the Theory of Experiments to Detect Aberration of the Second Degree. Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science. (To be published in the *Proceedings* of the American Academy of Science, and in the *Philosophical Magazine.*)

In this paper there is a reconsideration of the simple theory of aberration of the second degree as given by Michelson and Morley in 1887, and of the general theory as given by Hicks. The effects due to aberration of the first, second and higher degrees have been computed, and the results are shown in curves. The conclusion is that the original theory was correct and sufficient, and that the modifications proposed by Hicks are effective in aberration of the third or fourth degree only, or are (in two instances) due to errors in his theory.

Report of an Experiment to Detect Change of Dimension of Matter Produced by its Drift through the Ether. Edward W. Morley and Dayton C. Miller. (To be published in the *Proceedings* of the American Academy of Science, and in the *Philosophical Magazine.*)

The paper describes a large interferometer designed for the measurement of ether drift, and for the determination of any differential change in the dimension of matter, resulting from such a drift. The support of the optical parts is a steel truss-pattern cross, which is circumscribed by a square with diagonals fourteen feet long. By repeated reflections the optical path of the light is lengthened to two hundred and eleven feet. The whole interferometer is floated on mercury to render observations possible in all azimuths. The distances apart of the mirrors are determined by interchangeable rods, which may be of any suitable material. Experiments have been made using pine distance pieces, which give results in accordance with those of the original experiment made by Michelson and Morley in 1887 in which the distances were determined by sandstone.

The theory given in the preceding paper indicates a displacement of the interference fringes due to ether drift amounting to 1.53 wave-lengths, as the apparatus is rotated. The observations from 260 rotations show that the displacement is less than 0.015 wave-length. As the latter quantity is as small as the errors of observation, the conclusion is that there is no drift of the ether at the place where the interferometer is mounted.

Recent Experiments and Theories on the Ether Drift. D. B. Brace, University of Nebraska.

The Elimination of Gas Action in Experiments on Light Pressure. G. F. Hull, Dartmouth College. (To be published in the *Philosophical Magazine* and in the *Physical Review.*)

When light is thrown on one vane of a torsion system suspended in a partial vacuum, the 'Crookes effect' or gas action is eliminated, leaving only light pressure effective, in the following ways: (1) By making the vane accurately vertical; (2) by *enclosing* the absorbing or reflecting surface; (3) by making the vane a cylindrical surface having its axis coincident with the suspending fiber; (4) by using inclined surfaces and polarized light.

Experiments are described and data given showing that the gas action is eliminated through large ranges of air pressure varying from about half an atmosphere up to a few millimeters of mercury.

A simple lecture room experiment is described for demonstrating that light pressure on a reflecting surface is greater than that on an absorbing surface in the ratio of $1 + r_1 : 1 + r_2$, where r_1 and r_2 are the reflection coefficients of the two surfaces.

The Distribution of Energy in the Visible Spectrum. EDWARD L. NICHOLS, Cornell University. (To be published in the *Physical Review.*)

This paper gives definite numerical and graphical data for the variation of intensity with wave-length in the visible spectrum of various sources of light such as the Hefner lamp, the ordinary gas flame, the petroleum flame, the acetylene flame, the Nernst filament, the lime light, the magnesium light and the carbon arc light; also in the spectrum of incandescent bodies such as carbon, platinum and zinc oxide at known temperatures.

Hitherto our knowledge of these spectra has been relative, each being compared with some other taken as a reference standard. It is now possible, however, to reduce all spectrophotometric comparisons to absolute measure.

A Note on Interference with the Bi-Prism. WM. MCCLELLAN, University of Pennsylvania.

The condition that diffraction and interference lines obtained by means of the biprism shall be seen separately, depends on the relative positions of the screen prism and slit, and the angle of the prism. The writer has taken several photographs to illustrate the various fields which may be obtained from the same prism.

The Evolution of Hydrogen from the Cathode in Gases and its Association with Cathode Rays. CLARENCE A. SKINNER, University of Nebraska.

Exhibit of Liquid Air Machine in Operation. ARTHUR W. GOODSPEED, University of Pennsylvania.

DAYTON C. MILLER,
Secretary of Section B.

THE CONVENTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

THE eighteenth annual convention of this association was held in the Chamberlain Hotel, at Des Moines, Iowa, November 1–3. It was the first meeting under the new constitution, which reduces the number of sections from five to two; and the advantage of the new plan was very marked in enabling delegates to follow the discussions more closely, and in concentrating the deliberations upon questions of administration and methods of work. The two sections under the present constitution are (1) on college work and administration, and (2) experiment station work.

The general sessions were presided over by Dr. W. O. Thompson, of the University of Ohio, who delivered the customary presidential address. This dealt with 'Some Problems in the Colleges of Agriculture and Mechanic Arts,' and gave special attention to the agricultural phase of their work. Among the problems noted were the conditions in the agricultural communities, the much-discussed tendency away from the farm, and the frequent lack of opportunity on the part of the farmer's boy for individual initiative. It was urged that farm life must not be the refuge of necessity, that not all farmers' sons are suited to be farmers any more than all lawyers' sons are suited to that profession, and that marked changes in farming have taken place in recent years which call for special aptitude and training quite as much as any other work in life. It was pointed out that intelligent operation of the farm is now necessary for any margin of profit, and the fallacy that unintelligent men can make successful farmers or satisfactory farm laborers was denounced. 'We need to know that intelligence on the farm will produce results just as surely as elsewhere,' and this leads to the requirement for agricultural education.

It was pointed out that the agricultural colleges and the agricultural departments of these institutions have been working under the disadvantage of too little money, and that there has been a lack of appreciation that agricultural education must necessarily be a very expensive form of education, calling for extensive equipment which must be maintained at considerable outlay, and other items not commonly met with in laboratory work. A plea was made for the introduction of agriculture into the rural schools, and for an extension department of the college to stimulate interest in agricultural education in the rural communities. The agricultural colleges should furnish the inspiration and initiative for these movements, and there is need of conducting a propaganda in their interest, since agriculture differs from other industries in that it will not take care of itself. The speaker held that 'the problem of agricultural education will not be solved until the agricultural colleges have been brought into close and vital relations to the agricultural populations.'

The report of the executive committee, submitted by Dr. H. C. White, chairman, described the efforts of the committee in behalf of the bills for establishing mining schools at the land-grant colleges, and for the further endowment of the experiment stations, now pending in congress; and the conferences of the committee with the secretary of agriculture and other officials of his department relative to cooperation between the department and the experiment stations. The report led to the discussion of the relations of the experiment stations and their work to the department of agriculture.

In the course of the discussion upon this subject, a resolution was introduced by Dr. W. H. Jordan, of New York, recognizing the mutually advantageous relations which have existed between the department and the experiment stations of the several states, but recording the belief of the association that the continuation and development of these relations and the maintenance and progress of efficient research in agricultural science 'demand that the autonomy and paramount position of the stations as institutions of research and experimentation be inviolably maintained within their respective states, in accordance with the terms and spirit of the Hatch Act.' The resolution instructed the executive committee to request a hearing before the proper committees of congress, for the purpose of presenting the work and claims of the experiment stations, in order that congress may be properly informed as to the work of these institutions and its value to agricultural practise; and, furthermore, to continue conferences with the secretary of agriculture relative to cooperation between his department and the stations. This resolution was adopted by the association.

The committee on the collective exhibit of the agricultural colleges and experiment stations at St. Louis, through its chairman, Dr. W. H. Jordan, presented a progress report, briefly enumerating some of the features relating to the exhibit and noting the awards granted to it.

There were the usual reports of the bibliographer, by Dr. A. C. True, and of the committee on indexing agricultural literature, both of which enumerated the bibliographies and indexes to agricultural science which had appeared during the year; and the committee on methods of teaching agriculture presented a report on 'The Teaching of Agriculture in the Rural Schools,' with a syllabus of an elementary course in agriculture.

The report of the committee on graduate study reaffirmed the plan of conducting a graduate summer school of agriculture under the auspices of the association, and recommended that the school be held in future every two years, beginning, if possible, with the coming summer. The committee was empowered to arrange for the holding of such schools, and each agricultural college was requested to make an annual contribution of $25 to aid in their maintenance.

The committee on uniform fertilizer and feeding stuff laws submitted a brief report, through its chairman, Dr. H. J. Wheeler, which dealt in part with the question of nomenclature in reporting the results of analysis; this matter was subsequently referred to a special committee, to cooperate with a similar committee of the Association of Official Agricultural Chemists.

The committee on rural engineering reported, through Dr. W. E. Stone, the progress which has been made during the year in developing courses in agricultural engineering and farm mechanics at the land-grant colleges, and enumerated some of the benefits of instruction and investigation carried on by these departments. The need of a central agency in the Department of Agriculture was emphasized, to aid these new departments of the colleges, to carry on original research, and to establish laboratories for practical tests of implements, etc.

The committee on animal and plant breeding, through Professor W. M. Hays, reviewed the activity in research along these lines, and described the formation of the American Breeders' Association.

Resolutions paying an eloquent tribute to the late Major Henry E. Alvord, a former president and member of the executive committee of the association, were presented by President James K. Patterson, of Kentucky. These recorded the high esteem and affection in which Major Alvord was held by the association, and testified to his eminent services to agriculture in the various public and private capacities in which he served.

'The Social Phase of Agricultural Education' was discussed in a paper by President Kenyon L. Butterfield, of Rhode Island. He laid down the broad proposition that the agricultural college should serve as a social agency in helping to solve all phases of the rural problem, and pointed out that this was not merely a matter of technic, but a problem of economic, political and social significance. The present courses of study at the agricultural colleges were shown to deal almost exclusively with the technical phase, and the training of the individual to become a highly specialized expert. The introduction of rural economics and the spirit which it stands for was stated to be far more than the adding of two or three subjects of study to the agricultural course, but involved the socializing of the whole spirit and method of the college. The greatest need of American agriculture to-day was declared to be social leadership. It was argued that the college should assume this leadership and should train men and women for the service. A great enlargement of extension work among the farmers was advocated in order to teach the people who can not come to the college.

An address was delivered by Director William Saunders, of the Central Experimental Farm at Ottawa, Canada, on 'The Upbuilding of Agriculture.' This reviewed the development of agricultural education and experimentation in the United States and in Canada, and noted many of the material results of the experimental work in Canada and British Columbia, especially in the introduction and improvement of cereals by selection and breeding.

SECTION ON COLLEGE WORK AND ADMINISTRATION.

The program of this section included

some of the problems of livest interest to the land-grant colleges, and the discussion served to clarify the views on a number of important points.

The question as to how far the land-grant institutions should engage in teaching elementary subjects not generally recognized as belonging to the collegiate curriculum, was opened by a paper by President W. O. Thompson, who justified bringing the elementary instruction quite low down, on the ground of the lack of proper training in the rural schools, and also commended the short courses. Dr. R. H. Jesse, of Missouri, took the opposite view, and maintained that the remedy for the condition lay in the improvement of the public school system by the introduction of agricultural studies. While this was acknowledged to be the long way, as changes of this sort are slow of realization, he believed it to be the right way, which would justify itself in the long run. He disapproved of the establishment of agricultural high schools or preparatory departments for the agricultural colleges, but thought that the college of agriculture should rest on the public school system. Professor L. H. Bailey, of Cornell University, took a middle ground upon this question, holding that while these forms of elementary instruction do not properly belong in the college and are a temporary expediency, they are entirely warranted by the fact that the land-grant colleges do not at present articulate with the common schools. He believed that the final issue would be to prepare the public schools to prepare for the land-grant colleges, as they now prepare for the colleges of arts and sciences; but as this will occupy many years, perhaps a generation, he believed that the pressing problems of to-day must be taken care of, and on that ground defended the short and low-grade courses as temporary expedients.

Other speakers presented the local difficulties in confining the instruction to a four-year course, and maintained that the short courses had first aroused genuine interest and confidence in agricultural education, and that the more elementary grades of work did not obscure the college course. Under present conditions there is a large body of young men who are not and can not be prepared to enter the regular college course, and for these young men, who come to the college in increasing numbers, elementary and short courses were demanded.

The discussion of this question was continued in a paper by President J. L. Snyder, of Michigan, upon the subject 'What Can and Should be Done to Increase the Interest in and Appreciation for the Agricultural Side of Technical Training.' President Snyder urged that the courses in agriculture must be technical, and that the agricultural department must have equal advantages in the way of equipment, teaching force and buildings, with the other departments of the college or university. Short courses were advocated for those unable to take the longer courses. The speaker described what was done in Michigan to arouse interest in the agricultural work by maintaining close relations with the public schools, advertising the institution in various ways, and running excursions to the college during August, which the past year were attended by about 8,000 people.

Dean Davenport, of the University of Illinois, urged the need of differentiation of the subject of agriculture, and a larger number of instructors to cover different phases of the subject. Great progress has been made in this direction at a number of the institutions, but in many cases the teaching force was thought to be entirely inadequate. He made the point clear that the number of men to be taught should not be the unit in manning the staff of the agricultural department, as it has often been in the past, but that the true unit should be the subject itself. He pointed out that the University of Illinois now has more teachers in agriculture than it had students five years ago, and that as soon as the number of instructors was doubled the number of students doubled. He expressed the belief that the interest in agriculture on the part of the students was usually about in proportion to the number of instructors in that subject, and that greater differentiation and increased provision for teaching the various branches of agriculture would meet with the same result everywhere that it did at his institution.

A discussion of the degrees which should be given on the completion of the undergraduate courses in agriculture in the land-grant colleges, led by President G. A. Harter, of Delaware, brought out considerable difference of opinion, some contending for the B.S. and B.A. degrees, while others advocated the degrees B.Agr. and B.S.A. for the agricultural students, as more definitely expressing the courses which they had pursued.

The question as to the intent and purpose of the Morrill Act in regard to military instruction was introduced by a paper by President M. H. Buckham, of Vermont. The special interest in this subject has grown out of General Order 65 issued by the War Department, which prescribes the amount of military instruction which the officers detailed to the land-grant colleges for this duty are expected to require. Some of the institutions have found themselves unable to comply with these requirements, and as a result the detail has been withdrawn. President Buckham suggested that less emphasis be placed on the manual and technical branches of military training and more upon the intellectual topics in the military art, since the students at these land-grant colleges 'take military tactics as a part of a liberal education, not to fit them to serve as enlisted men.' The quite lengthy discussion following this paper showed that with the general advocacy of the importance of military instruction called for by the Morrill Act, there was a quite general dissent from the present requirements of the War Department; and the executive committee of the association was finally instructed to present the views of the association to the authorities at Washington.

SECTION ON EXPERIMENT STATION WORK.

This section considered the general subject of the breeding and improvement of plants and animals, and held a conference on the question of the amount of teaching which it is desirable for station workers to do.

The development of knowledge regarding methods of breeding plants and animals, and the working out of some of the underlying principles, were presented in a paper by Professor W. M. Hays, who expressed a strong belief in the importance of systematic work in breeding and its great commercial application.

Dr. T. L. Lyon, of Nebraska, spoke upon 'Improvement in the Quality of Wheat,' describing the methods which he is working out in this line as distinguished from selection for yield alone. Since a high yield and high nitrogen content do not necessarily go together, it was pointed out that there is danger in selecting wheat for yield alone that the quality will be injured, and hence it was maintained that the quality should be taken account of in breeding or selecting for yield.

Professor H. Snyder, of Minnesota, called attention to the difference in value of wheat for various purposes, and the lack of standards; and on his motion a committee of three was appointed on standards for determining the value of cereals.

In a paper on 'Animal Breeding,' Professor C. F. Curtiss, of Iowa, reviewed the work which is now being undertaken in animal breeding at the experiment stations of this country, and made some suggestions for work in that line.

In the conference upon the subject of 'How Much Teaching, if Any, is it Desirable that a Station Worker Should Do?' there was a lively discussion and a free expression of opinion, which seemed to be very largely in one direction. In opening the discussion Dr. H. P. Armsby, of Pennsylvania, showed that according to the latest statistics about 54 per cent. of the experiment station workers now do more or less teaching in the agricultural colleges, and that the tendency seemed to be toward an increase. He expressed doubt as to the advantage to the station man of doing college work, and he held that at all events it should be small and of advanced character. He believed that in this agricultural work a man should be chiefly either a teacher or an investigator, and maintained that, to a certain extent, the two kinds of work call for a different attitude of mind and the use of a different set of faculties.

Dr. W. H. Jordan held that the advantage of teaching, from the standpoint of the station man, depended quite largely upon the kind of teaching to be done, which in the case of the agricultural colleges is very largely the teaching of fundamentals. Such teaching he held to be of no advantage to the investigator, although he conceded that a small amount of teaching of an advanced character, along specialties with which the investigator is dealing, might prove advantageous.

It developed from the discussion that the plan of requiring this dual service from station men was regarded as largely one of expediency, and that the requirement of too much teaching from men holding important positions on the station staff had an unfavorable effect upon the general character of the station work. It was urged that the teaching should be so arranged on the college schedule as to interfere as little as possible with the time of the station worker, and that the tendency should be in the direction of restricting the amount of teaching and limiting it to advanced work. The discussion served to enunciate anew the true function of the experiment station as an institution primarily for the higher grades of experimentation and research, and emphasized more strongly than ever before the great need of a sharper differentiation of its work and its corps of workers from the instruction department of the college.

The extent to which specialization and equipment for agricultural instruction and investigation are being carried was exemplified at the Iowa State College at Ames, where the convention spent an interesting and profitable half-day as the guests of the institution. Here the large amount of live stock kept primarily for instruction purposes (over thirty head of horses of various breeds and types), the new pavilion for stock and grain judging, the well-equipped new department of farm mechanics, the commodious soils laboratory, the new dairy building in process of construction, and the plans for the new agricultural building to cost from $250,000 to $300,000, as well as the other departments of longer standing, were typical of the rapid advancement which is making in the material equipment for agricultural education, which will place that department on a par with engineering at the better institutions.

The officers of the association elected for the ensuing year were as follows:

President—E. B. Voorhees, of New Jersey.

Vice-Presidents—J. C. Hardy, of Mississippi; K. L. Butterfield, of Rhode Island; C. D. Woods, of Maine; E. R. Nichols, of Kansas, and E. Davenport, of Illinois.

Secretary and Treasurer—J. L. Hills, of Vermont.

Bibliographer—A. C. True, of Washington, D. C.

Executive Committee—H. C. White, of Georgia; J. L. Snyder, of Michigan; W. H. Jordan, of New York; C. F. Curtiss, of Iowa, and L. H. Bailey, of New York.

Section on College Work and Administration—Chairman, R. W. Stimson, of Connecticut; Secretary, K. L. Butterfield, of Rhode Island.

Section on Experiment Station Work—Chairman, H. J. Patterson, of Maryland; Secretary, M. A. Scovell, of Kentucky.

E. W. Allen.

SCIENTIFIC BOOKS.

The American Natural History, A Foundation of Useful Knowledge of the Higher Animals of North America. By William T. Hornaday. New York, Charles Scribner's Sons. 1904. 8vo. Pp. xxv + 449.

The object of this book is to make nature available to laymen; it is also particularly addressed to teachers and parents. It is intended to be plain, practical and direct, as well as systematic and scientific. The author has evidently striven (generally with good effect) to make his exposition simple and lucid, his diagrams and synopses mnemonic, his illustrations life-like, his style lively and personal. He has a proper abhorrence of mere closet naturalists as such, and much of the information presented he has won at first-hand during many years' experience as a field naturalist in America and the far east, and as director of the New York Zoological Park. Accordingly, we find here much practical and economic zoology, invaluable matter on the extinction of American species, and the setting right of many ancient and silly myths. As the field covered includes all the principal types of vertebrates found in North America, it is not to be wondered at that slips are to be detected here and there; and in regard to the author's ideas on classification we shall offer a few criticisms.

Clear exposition is exhibited in many sections of the book, notably in the chapter on the rodents. The genera and species are sketched in a manner that should be easily intelligible to the layman and useful to the general zoologist. The chapter dealing with the ruminants is also noteworthy. There are numerous excellent synopses arranged in brackets, and for each class of vertebrates there is a chart of the different orders. Admirable charts show the distribution of mountain sheep, elk, etc., and a convenient map of North America appears on the inner back cover.

The drawings, while of uneven merit, are full of life and action and have good teaching value. Many of them, as, for example that which represents the harpooning of a twenty-foot eagle ray, will surely arouse the enthusiasm of young readers.

Certain groups, *e. g.*, the ducks, are illustrated with great fullness. There are many photographs from life, among those of especial merit being the well-known photograph by Umlauff of an old male gorilla, the photograph by Professor Nathorst of a herd of wild musk oxen, the photographs of the white-tailed deer, bison, owls, pelicans, flamingos, condors, etc., and several of crocodiles; a most remarkable one is that by Beck showing a great multitude of the marine iguanas of the Galapagos gathered together on a rocky shore. There are excellent photographs of the principal snakes; and among Amphibians one photograph shows the northern tree frog with the vocal sack protruded.

The author aims to amuse as well as to instruct, as shown in the following typical passage:

> Whenever you see a brown-coated burrowing animal, the length of a small rat, but twice as thick, with a big pouch in the skin of each cheek, a swinish appetite, a set of long claws like burglars' tools on each fore foot and a most villainous countenance and temper you may know that it is a pocket gopher. The pockets in his cheeks are to enable him to carry extra large quantities of stolen potatoes and seeds.

It is regrettable that in the endeavor to be popular the author repeatedly ascribes human characteristics to those animals, such as pikes, for example, which, so far as we know, are utterly unlike man in their psychic constitution. The same straining for popularity also leads in a number of passages to sensationalism and 'rhetoric.'

Of the author's numerous first-hand observations of great value we may cite only the following:

> An alligator seized a fighting enemy by one leg, and using his tail as a propeller, whirled himself round and round like a revolving shaft, until in about five seconds the leg was twisted off, close up to the body!

Very noteworthy is the incident of the entombed live frogs in Ceylon, which were dug up in the dry bed of what in wet weather was a shallow brook.

Of melancholy interest are the full accounts of the extinction of the bison, and of other species of birds and mammals, and of the threatened extinction of the mountain sheep, bighorn, antelope, etc., for the preservation of which the author gives practical suggestions. Fishing and the fishery industries receive considerable attention.

Many popular fallacies and myths are set right. Bats never 'get in your hair.' Certain bats, birds and rodents suspected of injuring the farmer are shown to be his best friends. The gila monster is not ferocious and its bite is not necessarily fatal. No snakes are slimy; the tongue of a snake is never capable of inflicting a wound or conveying poison. Rattle snakes add more than one joint a year to their rattles. The gavial and mugger crocodiles of India are harmless to man, and so are the American crocodiles and alligators.

Of the errors, misstatements, misinterpretations and omissions observed we may note the following: The 'Missing Link' question is discussed, without any reference to the *Pithecanthropus erectus*. Now, whatever may be thought of this remarkable fossil, it should at least have been mentioned. The flippers of the manatee are described as 'well-nigh useless,' except to a limited extent in assisting to convey the food to the mouth. But the manatees in the New York Aquarium may be seen any day using their flippers to good effect in swimming about leisurely. The manatee is further said to be compelled to live on aquatic plants because its molar teeth are weak—but this is probably 'putting the cart before the horse.' The unique horizontal action of the upper lip of the manatee when pulling food into the mouth is not mentioned. Good opportunities to teach the very simplest and most interesting facts of comparative anatomy are neglected. For example, it is nowhere pointed out that birds' wings are modified reptilian hands, bearing long feathers—a fact which might easily have been mentioned in the references to *Archæopteryx*—that in the several groups of aquatic mammals the flippers represent modified hands and feet; that in hoofed mammals, for purposes of speed, etc., the ancient five-toed foot has been, as it were, made over and cut down into the odd-toed and the even-toed types (the use of the term 'divided hoofs' simply confirms a common misconception); that the hoofs of ungulates are really highly improved nails, etc.

The female kangaroo is stated to transfer the young at birth to her pouch by means of her paws instead of by her lips as stated by Owen and other observers. The monotremes are regarded (p. 359) as bridging over the chasm between the classes of birds and mammals, a thoroughly discredited notion. The African ostrich is described as a worthy *descendant* of the moa. *Apteryx* is stated to be 'absolutely without wings,' although Owen, T. J. Parker and Pycraft have all described the wings in great detail; the wings are vestigial, it is true, but they retain an elaborate musculature, spiny remiges and an alar claw. The gills of *Ceratodus* (p. 381) are stated to be small and imperfect and 'of little use.' But this is quite contrary to the observations of Semon.*

Throughout the book a curiously artificial importance is placed upon so-called 'zoological rank,' whether 'high' or 'low.' The Cetacea (perhaps the most complexly organized of mammals) are considered to be 'low' because they lack hair and are fish-like in form. The Dipnoi, we are told, are the 'highest' among fishes because most like amphibians; the eels are very low *because* they lack scales and paired fins!

In classification the author apparently does not trouble himself to distinguish similarities due to analogous, parallel or convergent evolution from similarities due to blood kinship.

* 'In the Australian Bush,' pp. 92, 93.

Thus he finds it convenient to separate probably related groups such as the Pinnipedia and the Carnivora, *Polyodon* and the sturgeons, but, on the other hand, he thinks the orders Anseres, Steganopodes, Tubinares, Longirostres, Pygopodes, Impennes 'might well stand as a subclass—the web-footed swimmers.' Whatever mnemonic value there may be in his classification of the fishes (which is based chiefly upon visible external characters), it must be admitted that the scheme is arbitrary, not expressive of kinships and far from representing the present state of ichthyology. The physostomous and physoclistous orders are scattered about indiscriminately the electric eel (*Symbranchus*, which is almost certainly an eel-like offshoot of the characines) is cited as a typical example of the order Apodes; the Pediculates are widely separated from the spiny-finned group and placed next to the 'foot of the subclass of bony fishes,' which place of slight esteem is assigned to the eels and *to the sea-horse group!*

W. K. Gregory.

SCIENTIFIC JOURNALS AND ARTICLES.

The February number of the *Botanical Gazette* contains 'The theory of respiration,' by C. R. Barnes, being an address as retiring president of the Botanical Society of America, and published also in Science of February 17. —H. N. Whitford has begun a discussion of the forests of Flathead Valley, Montana, being the results of his work as a collaborator in the U. S. Bureau of Forestry. The paper discusses the conditions that determine the appearance and nature of the forests of that region, and inferentially the nature of the conditions of forest development in other regions.—Theo. Holm publishes a study of *Munroa squarrosa*, both from the standpoint of its general characters and its anatomy.—C. J. Chamberlain presents the view of a botanist as to alternation of generations in animals, his theory being that the egg with the three polar bodies constitutes a generation comparable with the female gametophyte in plants; that the primary spermatocyte with the four spermatozoa constitute a generation comparable with the male gametophyte in plants; and that all other cells in the animal constitute a generation comparable with the sporophyte in plants. His lines of evidence are the gradual reduction of the gametophyte in plants, with the constantly diminishing interval between the reduction of chromosomes and the process of fertilization; and the phenomena of chromatin reduction in both animals and plants.—W. F. Ganong, in continuing his descriptions of new precision-appliances for use in plant physiology, describes an autographic transpirometer, an adjustable leaf clasp, and a leaf-area cutter.

The February number of the *Journal of Nervous and Mental Disease* opens with an article by Dr. Morton Prince, of Boston, on the course of the sensory fibers in the spinal cord as evidenced by a case of section of the cord. Dr. Prince discusses the function of the posterior columns with a leaning toward the view that they are largely for the conduction of muscular rather than tactile sense, and that at least one of the paths of conduction of tactile sense is in the lateral part of the cord. He goes over the reports of various experiments on animals, and then presents very carefully the case in point, resulting from a brawl between a couple of Italians and amounting practically to a vivisection experiment on a human being. Lack of space prevents giving his conclusions in full, but among them might be noted: It is proved that tactile sensations are conducted by other paths than the posterior columns, and this is probably although not positively true of pain as well. A path for sensibility must cross the cord. In the second article Dr. Frank R. Fry, of St. Louis, reports two cases of syphilitic disease of the cervical spine, belonging to a type characterized by a stiff neck with one or more points of tenderness on deep pressure, severe neuralgic pains, often not sharply localizable, no objective sensory changes, and no paralysis. Dr. F. X. Dercum, of Philadelphia, reports a case of trauma of the foot of the second frontal convolution, followed by ataxia, nystagmus and epilepsy, which improved after surgical interference. The October meeting of the Philadelphia Neurological Society and the November meeting of the New York Neurological Society are reported. The 'Periscope' includes abstracts of the following periodicals: *Neurologisches Centralblatt, Journal de Neurologie, Allgemeine Zeitschrift für Psychiatrie, Journal of Mental Science, Archives de Neurologie,* and selected articles from miscellaneous journals. T. S. Clouston's 'Clinical Lectures on Mental Diseases' and 'Traité de Medicine,' Vol. IX., Diseases of the Nervous System, are reviewed.

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The Red Beds of Southwestern Colorado: Whitman Cross and Ernest Howe.

During the areal mapping of the Ouray quadrangle, on the north side of the San Juan Mountains last season, a notable angular unconformity was observed immediately below a peculiar limestone conglomerate which has long been known to carry fragmentary remains of dinosaurs and crocodiles, with occasional plant and invertebrate forms, all of Triassic types (see Telluride and La Plata folios). Within a distance of two or three miles this Triassic conglomerate is seen to transgress the edges of 1,200 feet or more of unfossiliferous conglomerates, sandstones and shales, of typical Red Bed character, and several hundred feet of the Hermosa formation—Pennsylvanian Carboniferous. The Triassic beds are here but 50 to 200 feet thick, the La Plata Jurassic sandstone resting unconformably upon them.

This unconformity below the Trias shows that the major portion of the Red Beds section of the San Juan country is Paleozoic and the authors provisionally refer that portion to the Permian, and propose the name Cutler Formation for it, the Triassic Red Beds retaining the name Dolores, in accordance with the original definition of that formation.

The significance of this unconformity in interpreting the Red Beds sections of other parts of Colorado and the western plateau country was briefly discussed. This paper was read by title at the winter meeting of the Geological Society of America and will be offered for publication in full in the *Bulletin.*

Cause and Periods of Earthquakes in the New Madrid Area, Missouri and Arkansas: Myron L. Fuller.

The term New Madrid earthquake is applied to a series of shocks beginning late in 1811 and continuing to the early part of 1813, constituting one of the most remarkable examples of incessant quaking in a region far from any volcano for a period of many months. The shocks, though felt throughout nearly the whole of the country then settled, were most severe in southeastern Missouri, northeastern Arkansas and western Tennessee. Along the Mississippi there is said to have been a broad dome-like uplift of some twenty feet, while both to the east and west the land was depressed, forming the broad 'sunk land' districts. The uplift resulted in the drainage of many lakes and bayous, while the depression gave rise to basins into which waters flowed, killing the existing timber. Among other characteristic features of the earthquake was the opening of immense cracks, often several feet across and many feet in depth, and the formation of craterlets, through both of which large amounts of lignite-bearing sands were ejected, probably giving rise to the broad areas known as sand-slews where the surface, even to-day, is in places a barren, sandy, timberless waste, upon which only weeds will grow. The submerged stumps, slews, craterlets and cracks were still visible in 1904 when a trip was made to the region by Professor E. M. Shepard, C. B. Bailey and the speaker. Professor Shepard, who gave much attention to the cause of the earthquake, believes that the conditions are such as would result from the undermining action of ground waters under artesian pressure and which are thought to have escaped in the past, as possibly at present, along some of the streams by springs bringing up sand and lignite. The equilibrium being destroyed by a readjustment of some Ozark or other fault, cracks were formed and sand and water ejected in large amounts, permitting the settling described. The speaker, however, believes that there was no preliminary undermining, but that the sinking was brought about because of the extrusion at the time of the quake of large amounts of the quicksand underlying the clay, which, when saturated with water, flows almost as readily as water alone. Observation on the ages of trees in the cracks brought out the fact that some fissures were formed a hundred years or more before the recorded quake, while inquiry of the inhabitants shows that earthquakes are still of almost annual occurrence and are accompanied by similar but less pronounced phenomena than those accompanying the quake of 1811, indicating that the latter was simply an acute stage of a readjustment which has long been going on and is still in progress.

Some Crystalline Rocks of the San Gabriel Mountains Near Pasadena, California: Ralph Arnold, Washington, D. C., and A. M. Strong, Independence, California.

The San Gabriel Mountains, comprising an area of about twelve hundred square miles, extend for fifty miles in a west-northwesterly direction from Cajon Pass in San Bernardino County, to the Santa Clara River in Los Angeles County. Considerable divergence of opinion regarding the age of the chain has prevailed among previous writers, but it is probable that it received at least the greater part of its elevation during late Eocene or Oligocene time.

The southern range of the chain, the Sierra Madre, is composed principally of granodiorite and gneiss, with some associated quartz-monzonite and gabbro and intruded aplite, quartz-hornblende-porphyrite and diabase porphyry. The central portion of the mountains consists of somewhat coarser grained granites and granodiorites with intruded aplite, micropegmatite, etc.

The granites described are of the biotite variety and are found in the central part of the chain. The granodiorites consist of two facies, a fine-grained hornblende-bearing variety from the Sierra Madre and a somewhat coarser grained variety containing porphyritic orthoclase from the central mass. These granodiorites differ from those found in the Sierra Nevada of central California by being on the average finer grained and having less quartz, titanite and zircon. Gabbro, consisting mostly of hornblende, but also containing a little plagioclase, is found in small masses or dikes throughout the whole area. Aplite is found over the whole region in question, while micropegmatite was found only in the central portion of the chain. Quartz-hornblende-porphyrite and diabase porphyry occur in dikes in the southern range. Of the metamorphic rocks, hornblende-diorite-gneiss is by far the commonest. It and some biotite-granite-gneiss are associated with the granodiorites and quartz-monzonites of the Sierra Madre. Hornblende-schist and garnetiferous schist, found by the writers only in the southern range, complete the list of crystalline rocks described.

The Question of the Origin of the Natural Mounds of Louisiana: A. C. Veatch.

Of the many theories of origin suggested for these mounds three deserve the most careful attention: (1) the spring and gas vent theory, (2) the dune theory and (3) the ant hill theory.

In the spring and gas vent theory it is argued that the gas produced by the decay of the large amount of vegetable matter buried in the coastal plain strata has, with the artesian water associated with it, brought to the surface fine sand and built up low cones. Small cones are now forming in this manner at many points in the coastal plain, and they were pointed to as proving this hypothesis. The fatal objection to this theory is that entirely identical mounds are found in Indian Territory on flat plains underlaid by highly inclined carboniferous shales and sandstones, where the substructure clearly lacks the elements required by this hypothesis.

The dune theory is based on the resemblance of these mounds to the low dunes which collect in the semi-arid region of the west about clumps of low vegetation. The objection to this theory is the great irregularity of wind-made features and the very notable uniformity in size and exact resemblance one to another of these natural mounds of the south central United States over an area at least 300 miles wide and 500 miles long. It would seem that in so large an area a wind origin would involve a greater variation in size than has been observed, and necessitate the presence of occasional dunes, or lines of dunes, of noteworthy size whose origin could not in any way be doubted.

In the ant hill theory two possible lines of development were suggested: (1) That the mounds are the work of the *Atta*, or leaf-cutting ants, (2) that they are the remains of hills of a mound-building variety of white ants, the termites. According to Professor W. M. Wheeler, *Atta* hills in western Texas reach a diameter of forty to fifty feet and a height of one to two feet; and Mr. E. A. Schwarz, of the National Museum, reports that the *Atta* hills in Cuba often reach a height of ten to twelve feet and a diameter several times as great. These occurrences are considered to add greatly to the possibility of an ant origin.

Regarded as the work of mound building termites, which are now restricted to the tropical regions, these mounds suggest a warmer and moister climate. Modifications such as those which permitted large elephants, camels and animals of the sloth and armadillo families to live in this region would also have permitted these now similarly restricted mound-building termites to do the same; and the causes which resulted in the extinction of the larger animals would also, though at a later date, have destroyed the mound-building termites.

Of the theories of origin yet suggested none are entirely satisfactory, and the dune and ant hill theories are the only ones well supported. If either of these hypotheses is correct the mounds are indications of important climatic changes in very recent time. It was suggested that the matter should be approached by the careful excavation of a number of these mounds at widely different points in order to fully determine the relation of the mounds to the beds which underlie them and to the soil surrounding them.

H. F. Bain,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

The fiftieth regular meeting of the club was held Friday, December 16. By way of special observance of the occasion, Professor M. B. Hardin, the first president of the club, gave informally a brief account of the organization and early days of the club, and recounted some of the more interesting of the former programs.

Professor T. G. Poats discussed 'Recent Advances in Astrophysics,' dwelling particularly upon those made possible by the use and improvement of the spectro-heliograph.

Professor Harmon Benton, under the head of 'Economic Possibilities of the May-pop,' gave an account of his preliminary experiments in improving the wild may-pop (*Passiflora incarnata* L.) by increased fertility of soil, selection and crossing upon the edible species of *Passiflora*. Results to date indicated that the plant responded readily to improvement, and its development into an economic fruit can be predicted with no little certainty. These experiments will later be published as a bulletin of the South Carolina Experiment Station.

Dr. P. H. Mell gave an account of the Des Moines meeting of the Association of American Agricultural Colleges and Experiment Stations and Professor C. E. Chambliss reported on the boll-weevil convention at Shreveport.

The fifty-first regular meeting on Friday, January 20, was given up to reports from those who attended the Philadelphia meeting of the American Association: Dr. P. H. Mell, Professor P. T. Brodie, Professor C. E. Chambliss and Dr. Haven Metcalf, reporting on the work of the sections and affiliated societies in geology, engineering, entomology and botany, respectively.

Haven Metcalf,
Secretary.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY.

At the January meeting Dr. W. M. Wheeler assumed the chairmanship for the year 1905. Papers were presented by Dr. Esther F. Byrnes and Dr. Wheeler.

Dr. Byrnes described 'Transitional Stages and Variations in some Species of *Cyclops*.' The species *C. signatus* occurs sexually mature in morphologically incomplete stages. It is then characterized by eleven antennal segments instead of the adult number, seventeen; and is comparatively small in size and pale in color. Large numbers of adults of the type *C. viridis* show striking variations in the armature of the swimming feet. Similar antennæ and fifth feet are correlated in one type of individual with the swimming feet of *C. parcus;* in another form with *C. viridis* (var. *Americanus*) and in another with *C. brevispinosus.* Occasionally serial and lateral variations combine the swimming feet of *C. parcus* and *C. brevispinosus* in the same individual. These facts, together with the frequent replacement of setæ by spines, the constant association of the forms and their occasional sequence in small aquaria, indicate a very close relationship among the species observed and suggest that they are transitional forms in the development of a single species.

Dr. Wheeler described the structure and ecology of many 'ants that raise mushrooms,' giving special attention to the species of Texas and Mexico, where his own studies of these ants were made. Numerous lantern slides illustrated this lecture; and at its close many slides from photographs of ants kept in captivity by Miss Adele M. Fielde were exhibited.

M. A. Bigelow,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

The 158th meeting of the Elisha Mitchell Scientific Society of the University of North Carolina was held in the chemical lecture room, Tuesday evening, February 14, at 7:30 o'clock. The program was as follows:

Dr. R. H. Whitehead: 'Mode of Infection of the Hookworm Disease.'

Professor Archibald Henderson: 'The Mystic Hexagram.'

Professor C. L. Raper: 'Statistics of Cotton Manufacturing in the South.'

Alvin S. Wheeler,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

MONT PELÉE SIVE MONT PELÉ.

It is a curious coincidence that geologists who affect the title of 'Mont Pelé' in preference to the formal appellation of Pelée, should have associated, so far as identity of names is concerned, the tutelary divinity of volcanoes amongst ancient Hawaiians with the island of Martinique. We are assured, however, that the innovation has not been made with the idea of reverencing the goddess, but out of regard for rules of gender, Pelée being considered an adjective adopted from the Spanish, as one contributor to Science has it, or from Carib speech, according to another. Admitting either of these explanations, it is easy to see that Spaniards or Caribs must also have had a hand in christening an island by the same name off the coast of France.

In reality, Pelée has continued to be a word of good and regular standing in the French language since the time of the Norman Conquest, the expression of 'une verge pelée' occurring in the 'Chanson de Roland,' supposed to be of the early eleventh century. Strictly speaking, the word is a past participle of *peler,* which, with the co-derivatives of *pelare* in Italian, *pelar* in Spanish, and *peel* in English, comes from the Latin *pilare.* Now it happens that large numbers of past participles have become preserved in modern French as substantives, some masculine, but the majority feminine—as for instance, *allée, mêlée, gelée, fumée,* etc. And we have the authority of La Fontaine, in his 'Fables,' to say nothing of colloquial usage both in French and German, for considering the word meaning bald as a noun.

Applying this principle to place names, Pelée may be regarded as having acquired the force of a substantive, like our own 'Rockies.' It is true that Rocky and Bald may connote the character of mountains, but the adjective force of these words becomes lost when they stand for geographical appellations. Indeed, names like Big Sandy, Vera Cruz, Jungfrau, Sacré-Cœur, and so on, are nouns pure and simple. By treating Pelée as a noun, we shall have the advantage of an invariable termination, thus doing away with a dual orthography, or the possibility of a triple, in case we were writing in German.

As regards the question of gender it may be remarked that in the case of geographical nouns this is extremely arbitrary; and, moreover, in all inflected languages, words very often undergo transformation in gender during course of time. Le Péloponnèse, for instance, has a feminine termination, but is of the masculine gender; and Galilée may be of either gender. Val, feminine in the Latin *vallem,* and still feminine in French proper nouns, has become masculine by common usage, taking the plural *vaux* by analogy with *mal, cheval,* etc. Some words, like *sang,* are masculine in certain combinations, and feminine in others. Finally it can hardly be claimed that the form 'Mont Pelée' does violence to a language which authorizes us to place the feminine article before *bon-bec,* and the masculine before a variety of words like *rouge-gorge, rouge-queue, cent-garde, grand' croix, patte-pelu,* etc.

C. R. EASTMAN.

HARVARD UNIVERSITY.

THE METRIC FALLACY.

TO THE EDITOR OF SCIENCE: In a recent article in SCIENCE on the discussion of the metric question in the House of Lords, Dr. Seaman repeats with approval the claim as to the great saving of time that would be accomplished in school by the use of the metric system. This claim has been one of the chief supports of the metric cause for generations, and has remained practically unchallenged except by a general denial. The forms in which is was presented in the House of Lords last February and in the report of our House Committee on Coinage, Weights and Measures in 1902, are so typical of this claim that both are given here:

Lord Belhaven, in House of Lords, February 23: "There is a great waste of time in the education of children, through the learning of the arithmetical tables and their application. Out of 221 school-masters consulted, 212 replied. One hundred and ninety-seven stated that there would be a considerable saving of time if the metric system were introduced; of these, 161 estimated the saving at one year; 30 estimated it at two years; and six went so far as to estimate it at three years."

Report of the Committee on Coinage, Weights and Measures to the House of Representatives, April 21, 1902: "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. * * * Teachers and pupils alike unanimously testify as to the case 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."

This argument has been reiterated with so much emphasis and with such a show of authority that it has unquestionably carried conviction to the minds of thousands. The opinions of experts regarding their own trade are ordinarily accepted by others. If educators say the metric system would effect a saving of one to three years in the school life of a child, why should it not be accepted as true?

Within a few weeks Frederick A. Halsey has applied the scientific method to the school children argument, and, in view of its general acceptance, with startling results. It is to him that I am indebted for the data on this point. In the report of the course of study for elementary schools, dated May 27, 1903, the board of education of New York city gave a time schedule for each study for the eight years. This schedule is based on 1,500 minutes per week, and the time allotted for all branches of mathematics amounts to $34\frac{1}{3}$ weeks for the eight years. No reliable data is available as to the proportion of this time occupied in the study of weights and measures; 20 per cent. of the text-book on arithmetic, however, is occupied by the chapters on compound numbers, weights and measures. In order to be liberal to the metric cause we will apply this rate, 20 per cent., to the whole time, including that occupied with algebra and geometry. The total time devoted to the study of compound numbers, weights and measures during the eight years of school life by this liberal estimate amounts to 6.8 weeks, from which the introduction of the metric system is to save from one to three years.

It would seem as if absurdity in advocating the metric system could go no farther. The exposure of this metric fallacy is not an occasion for ridicule, directed at Lord Belhaven, the House Committee on Coinage, or others who have accepted it in good faith. It is rather a cause of humiliation that such an absurd pretence regarding education should have been spread broadcast, not only without dissent from the schools, but with their enthusiastic approval. Have our educators become so accustomed to receiving and imparting information by mere authority that they have lost the power of analysis?

Dr. Seaman refers to the English system as 'the complex, irregular and barbarous system now in vogue.' Again, Professor J. H. Gore, of the Society for the Promotion of the Metric System, is thus quoted in *School Science:*

> We send consular representatives to every quarter of the globe for the express purpose of making possible an extension of our foreign commerce, and then busy ourselves in an attempt to make such commerce impossible, and retain a system of weights and measures which adds to our own difficulties and makes us mere barbarians to the more progressive nations.

The metric advocates, while accepting the wild and extravagant claims for the metric system, treat our own system with contempt. Nevertheless, the scientific method that exposes the hollowness of their claims also proves that the English system is intrinsically the best and, as far as uniformity is desirable, the most uniform system on earth. It is the standard of the richest portion of the earth's surface; of the two most enlightened, populous and powerful nations on earth; and of the only nations that control vast unsettled regions to accommodate the increase of their population. It is the standard of the past and present, and the world trend points to it as the standard of the future.

Dr. Seaman states that:

> Any one who will take pains to inquire of any of the thousands of immigrants that come among us, will convince himself that the metric system is the principal system in actual use in trade and commerce in European countries.

For two years I have been taking pains to do this very thing, and have been convinced by it that the European immigrants know very little about the metric system. A few typical examples: An Italian from Naples was acquainted with the 'kil,' but knew nothing about the meter, his ideas of length being based on the *can,* which he informed me was something less than eight feet. A Swede said that while the metric system was used in the stores in his country, the *tunland* and *hemend* were used for measuring land. An Austrian was ignorant of metric measures, but was familiar with the *pfund* and *zoll.* An educated German informed me that the metric system was the only one used in Germany, but added: "Aber das Volk braucht die alten Masse." A Greek had heard that the 'kil' was used in Italy, but did not know what the metric system was. His standard of weight was the *oka.* Greek land, he said, was measured by the *stremma.* When asked how cloth was measured in Greece, his wife replied: "By the *pik.*"

With all it was the same story, ignorance of metric units, familiarity with their old standards. None expressed any ideas of measure to conform with those of any other nationality until I talked with a Russian. Scratch a Russian and you will find an Englishman—in measures. His standards of linear measurement are either the same as or commensurable with the English inch. His *duim* is our inch; his *archin* is 28 inches; his *verschock* is $1\frac{3}{4}$ inches; his *sagen* is 7 English feet; and his *verst* is 3,500 English feet. Two hundred years ago, Peter the Great, while in Holland, was impressed by the superiority of the English vessels that visited the Dutch ports. This led him to visit England, where he worked as an ordinary carpenter in the English shipyards. When he returned to Russia he took back with him four mast makers, four boat builders, two sail makers, and about twenty other workmen to teach their trade to his people. Thus without coercive laws, but peacefully and naturally, the English system was introduced into Russia, and to-day is the basis for all linear measurements throughout that vast empire. The inch carried by the English settlers to Jamestown in 1607, and that taken by the English carpenters to St. Petersburg in 1698 were the same; and the Russian emigrant, landing in America in 1905, finds the linear measurements of his new home commensurable with those of the land he has left.

Compare this uniformity of popular usage with the chaos of incommensurable standards wherever the metric system has been forced by law into conflict with the old standards of the people. One is the result of English evolution; the other, of French revolution.

Samuel S. Dale.

Boston, Mass.,
January 17, 1905.

SPECIAL ARTICLES.

DETERMINATE MUTATION.

Among the significant results obtained by Professor de Vries in his breeding of *Œnothera lamarckiana,* and by Dr. MacDougal breeding the same species in the New York Botanical Garden, there is one feature which seems to have attracted less attention than it may deserve. Most of the seven mutants observed by de Vries, and of the thirteen seen by MacDougal, have appeared more frequently than would be natural were the mutations wholly fortuitous and indeterminate.

In the Amsterdam garden the mutant *albida* appeared in four different generations from *lamarckiana* parents, previous to 1902, 15 *albida* appearing in one generation, 25 in another, 11 in another and 5 in another. *Nanella* appeared 5 times in one generation, and in other generations, respectively, 3, 60, 49, 9, 11 and 21 times. *Lata, oblonga rubrinervis* and *scintillans* appeared frequently.

In the fourth generation along with 14,000 *lamarckiana* plants there appeared 41 *gigas,* 15 *albida,* 176 *oblonga,* 8 *rubrinervis,* 60 *nanella,* 63 *lata* and 1 *scintillans,* all bred from *lamarckiana* seed. In the fifth generation, similarly bred from pure *lamarckiana* seed, among 8,000 *lamarckiana* plants were found 25 *albida,* 135 *oblonga,* 20 *rubrinervis,* 49 *nanella,* 142 *lata* and 6 *scintillans.* In the fourth generation one plant in 80 was *oblonga.* In the fifth generation one plant in 60 was *oblonga.* De Vries himself says: "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."

De Vries writes of *Œnothera oblonga:*

> Meist etwa sechsten Blatte sind die jungen Pflänzchen dieser Art mit Sicherheit zu erkennen, also etwas später als *O. lata* und *O. nanella,* und wesentlich früher als *O. rubrinervis* und *O. scintillans.* Die Blätter sind schmal, lang gestielt, ziemlich scharf vom Stiele abgesetzt, mit breiten, blassen, auf der Unterseite oft röthlichen Nerven. In Aussaaten sind die *O. oblonga* nur bei sehr weitem Stande früh und gleichzeitig zu erkennen, aber wenn man in den Versuchen von Zeit zu Zeit die unzweifelhaften *oblonga*-Exemplare auszieht, so zeigen sich die Merkmale bald in weiteren und weiteren Individuen, ohne dass diese dazu viel Raum brauchten.
>
> In den ausgepflanzten Rosetten erhält sich die angegebene typische Blattform. Einige Exemplare treiben Stengel, andere werden zweijährig. In beiden Fällen bleiben die Pflanzen niedrig, erreichen kaum 1 m Höhe und sind auffallend kleiner, als die in derselben Weise cultivirten Exemplare von *O. Lamarckiana.* Die einjährigen verzweigen sich wenig. Die Zweige bleiben meist kurz, Die Aehren sind dicht mit Blüthen und Knospen besetzt; die Blüthen kleiner als bei *O. Lamarckiana,* sehr arm an Blüthenstaub und nur ganz winzige Früchtchen mit wenigen Samen aussetzend. Die zweijährigen verzweigen sich kräftiger und sind mit Pollen reichlich versehen; sie bilden zwar kurze, aber dicke Früchte, welche eine reiche Samenernte geben.
>
> Bei fortschreitender Blüthe erkennt man die *oblonga*-Exemplare schon von Weitem an den dichtgedrängten, aber kleinen unreifen Früchten.

This mutant, therefore, differs from the parent species, *lamarckiana,* not in a single feature, but in an elaborate complex of characters. The other mutants likewise are distinguished from *lamarckiana* by a complex of characters rather than by a single feature. Speaking of the contrast between reversions and progressive mutations, de Vries says:

> * * * ordinarily they [reversions] deviate from the species in but a single character * * * . Quite different from this are the mutations of *Œnothera*. 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 * * * .

The mutations can hardly be entirely fortuitous if, for several generations, out of every thousand offspring of pure *lamarckiana* parents, there appear more than ten plants marked by the particular complex group of characters which designate *oblonga*. Were *oblonga* demarcated from *lamarckiana* by but a single character it would be remarkable to find it appearing repeatedly and in such numbers. When we remember that it is defined by an extensive series of characters differentiating it from *lamarckiana* and from all the other mutants observed, are we not led to the conclusion that mutation in *Œnothera lamarckiana* is not wholly fortuitous, but is to a degree predetermined; that there is some tendency to the production of the *oblonga* and other types in numbers much greater than would be secured by purely fortuitous and indeterminate mutation?

It seems of much interest that the evidence from paleontology in favor of determinate variation (or mutation) should be borne out by such careful observations as those of de Vries in so different a field of research.

I confess I do not quite understand Professor De Vries's statement—'In my experiments the mother species mutates *in all directions* [italics mine], in nearly all organs and characters, as well as for better or worse." I can not see that the published descriptions of his observations do show mutation in all directions. They seem to show rather the continued reappearance of but a few (7) distinct types of mutation. To be sure, MacDougal finds thirteen instead of seven of these mutants from *Œnothera lamarckiana*, but this is far from mutation in all directions. De Vries apparently meant merely to urge that the mutations were in several different directions and were such as could hardly be due to direct environmental influences, and not to claim that the mutations were purely fortuitous and indeterminate.

MAYNARD M. METCALF.

THE WOMAN'S COLLEGE OF BALTIMORE,
January 18, 1905.

CURRENT NOTES ON METEOROLOGY.

THE TEACHING OF METEOROLOGY.

PROFESSOR CLEVELAND ABBE, of the U. S. Weather Bureau, delivered an address upon 'The Introduction of Meteorology into the Courses of Instruction in Mathematics and Physics,' before the Physics and Mathematics Section of the Central Association of Science and Mathematics Teachers, on November 26 last. This address has now been reprinted, and constitutes a strong plea for more instruction along meteorological lines in various courses in mathematics and physics in which meteorological problems could well be dealt with. Professor Abbe regards meteorology 'not so much a matter of observation and generalization as matter of deductive reasoning,' and rightly believes that our meteorological studies have *approached*—he does not say *reached*—the limit of what is likely to be discovered as the result of inductive processes. He does not suggest the introduction of a new study into the already overcrowded curriculum of schools and colleges, but he would have problems in mathematics and physics selected from among the many phenomena of the atmosphere which need investigation. Thus, among a few special subjects which are enumerated, we find the simpler applications of trigonometry in the determination of cloud heights and velocities, by means of the simpler methods, such as Lambert's and Feussner's, and by the use of the theodolite, photogrammeter and nephoscope; the theory of the wet bulb thermometer; the hypsometric formula of Laplace; thermometer corrections; the formation of a waterspout by Weyher's method; and the study of the wind velocity, pressure, temperature and dimensions of the cloud column. Professor Abbe's paper is suggestive, and points the way toward a considerable possible extension of sound meteorological education by utilizing the mathematical and physical machinery already in operation.

LABOR AND HEALTH ON THE ISTHMUS OF PANAMA.

HON. JOHN BARRETT, American Minister to Panama, discusses 'The Panama Canal and its Problems,' in the *Review of Reviews* for February. He points out what is well known to all who have made any study of the matter at all, viz., that 'the average white laborers of the United States can not possibly stand the tropical climate,' and favors the plan of securing Jamaica negroes to do the work on the canal. Up to the present time the governor-general of Jamaica has insisted on conditions, under which alone these Jamaicans can go, that have not commended themselves to our Secretary of War and to the chief engineer of the canal. It is stated that the Jamaicans themselves are anxious to secure work on the canal. Plans are also being discussed for bringing in Porto Ricans, Chinese and Japanese, and there is said to be a growing feeling on the isthmus that the Chinese may be the laborers upon whom the Canal Commission will have to depend. Unless we are mistaken, however, the Chinese laborers imported by the French engineers to work on the canal did not prove satisfactory.

Under the lead of Col. Gorgas, who made a brilliant record as health officer at Havana, splendid efforts are being made to kill the mosquito-carriers of yellow fever and malaria, but both sufficient money and an extended organization to prosecute the work are lacking. During the past six months there have been about fourteen cases of yellow fever.

NOTE.

A PAPER on the 'Geography of Manchuria,' in the *Journal of Geography*, for January, 1905, contains a brief discussion of climate. The author is Professor N. M. Fenneman, of the University of Wisconsin.

R. DEC. WARD.

SCIENTIFIC NOTES AND NEWS.

SIR MICHAEL FOSTER has decided to offer himself for reelection to the next parliament as member for the University of London. He seeks reelection as a representative of science and higher education; if reelected he will take his seat as a member of the liberal party. A committee, with Sir Thomas Barlow as chairman, has been formed to promote his election.

THE Prussian Academy of Science has awarded its Helmholtz medal to Professor Ramón y Cajal, professor of neurology at Madrid.

THE Munich Academy of Sciences has awarded the Liebig medal for researches in agricultural chemistry to Dr. Adolf Frank, of Charlottenburg.

THE Royal Astronomical Society has awarded its Jackson-Gwilt bronze medal to Mr. Tebbutt, who for many years has carried on alone astronomical research in an observatory at his home in New South Wales.

M. JANSSEN, director of the observatory at Meudon, and M. Moissan, professor of chemistry at the Sorbonne, have been elected members of the St. Petersburg Academy of Sciences.

PROFESSOR SVANTE A. ARRHENIUS, of Stockholm, Professor W. F. P. Pfeffer, of Leipzig, and Professor W. Spring, of the University of Liège, have been elected honorary members of the German Chemical Society.

THE Physical Society of Frankfort has elected Professor E. Bamberger, of Zurich, and Professor J. Brühl, of Heidelberg, to honorary membership.

M. VIGER has been elected president of the French Society of Horticulture.

M. RADAU has been appointed president of the French Bureau of Longitude.

The Journal of the American Medical Association calls attention to the fact that the new French Cabinet contains two physicians, Dr. A. E. Gauthier, who is at the head of the department of public works which includes railroads, etc., and Dr. J. Dubief, minister of commerce. The latter was chief of the Marseilles Insane Asylum, 1886–1893, and then of the Rhone Asylum until elected deputy a year or so later. He has been a member of the committee on labor since 1902. The under-secretary of finance is also a physician, Dr. Merlou, who has served as deputy since 1889.

Dr. George Bitter, docent in botany at Münster, has been appointed director of the Botanical Garden at Bremen.

Dr. H. Ludwig, of Bonn, has declined a call to the directorship of the zoological museum of the University of Berlin.

Dr. Michele Cantone, professor of physics in the University of Pavia, has been appointed director of the Physical Institute at Naples.

Dr. Robert Stein has been transferred from the U. S. Geological Survey to the Bureau of Statistics, Department of Commerce and Labor.

Mr. Albert F. Woods, chief pathologist and physiologist of the Bureau of Plant Industry, United States Department of Agriculture, has been designated delegate on the part of the United States to the Second International Botanical Congress to be held at Vienna, June next. This action was taken by the secretary of agriculture through the secretary of state in response to a request from the government of Austria-Hungary to the government of the United States for official representation.

The Carnegie Institution has continued for two years in the future its annual grant for the payment of salaries to computers on the 'New Reduction of Piazzi's Star Observations.' But the work is much retarded by the lack of competent computers and suitable environment for their maintenance.

Professor Amadeus W. Grabau, of Columbia University, has received an extensive collection of fossils from the limestone region of Michigan, including many new types. He is to prepare a monograph on them for the State of Michigan.

Mr. Walter Maunder, who has conducted the astronomical department of *Knowledge* since the death of Mr. A. C. Ranyard in 1894, has resigned his connection with that journal.

It is proposed to erect a monument at Laibach, in Austria, to the memory of Vega, author of the well-known table of logarithms.

The Paris Mint has struck a medal in honor of Dr. B. Teissier, who died at the age of 23 from the consequences of an official medical mission to Egypt.

Professor Albert B. Prescott, professor of organic and applied chemistry, dean of the school of pharmacy and director of the chemical laboratory of the University of Michigan, died on February 26 in his seventy-third year.

We regret also to record the death of Dr. Hermann Landois, professor of zoology at Münster, at the age of seventy years; of Dr. Paul Uhlich, professor of geodesy of the Academy of Mines at Freiberg, at the age of forty-five years; and of Guido Hauck, professor of geometry in the Technical Institute of Berlin.

The next meeting of the Central Branch of the American Society of Naturalists and affiliated societies, the Central Branch of the American Society of Zoologists and the Botanists of the Central States, will be held at the University of Chicago on Friday and Saturday, March 31 and April 1, 1905. Titles of papers should be sent, together with abstracts of the same, to F. R. Lillie, secretary of Zoologists, or to H. C. Cowles, secretary of Botanists. A more extended notice of the program will be published in Science shortly before the meeting.

The general meeting of the American Philosophical Society will be held at Philadelphia on April 12, 13 and 14. Members intending to present papers are requested to send the titles to the secretaries without delay, so that they may be inserted in the preliminary program, which will be issued about March 10.

The January meeting of the Physico-Chemical Club of Boston and Cambridge was held at the Harvard Union, and papers were read by Professor T. W. Richards, Dr. H. A. Torrey and Dr. G. P. Baxter, all of Harvard. The subjects were respectively, 'The Atomic Weights of Sodium, Strontium and Chlorine,' 'The Dissociation of Phenoquinone and Quinhydrone' and 'The Oxidation of Oxalic Acid by Permanganate in the Presence of Hydrochloric Acid.'

The annual general meeting of the Neurological Society of Great Britain was held on February 16, when the presidential address was delivered by Sir John Batty Tuke. The subject of the address was the relation of the lunacy laws to the treatment of insanity.

The proceedings of the American Forest Congress, held at Washington, D. C., January 2–6, under the auspices of the American Forestry Association, will be issued in book form on March 15. The volume will contain about 400 pages, and will be bound in cloth. It will contain the complete addresses by President Roosevelt, Secretary Wilson and fifty other speakers who were on the program, including not only those prominent in state and national forest work, but the leaders in the railroad, lumbering, mining, grazing and irrigation industries. It will be published for the American Forestry Association by the H. M. Suter Publishing Company, Washington, D. C.

The seventh Australasian Medical Congress will be held in Adelaide, South Australia, from September 4 to 9, 1905, under the presidency of Dr. E. C. Stirling.

The Massachusetts Zoological Society acknowledges gifts amounting to $12,900 towards the establishment of a zoological garden.

A telegram has been received at the office of the Scottish National Antarctic Expedition in Edinburgh announcing the safe arrival at Buenos Ayres of Mr. R. C. Mossman, who was left in charge of the meteorological station at Scotia Bay, South Orkneys, last February. Mr. Mossman has spent two continuous years in the Antarctic regions.

The Adams prize for 1904 has not been awarded by Cambridge University. The subject for the prize for 1906, which is open to the competition of all persons who have at any time been admitted to a degree in the university, is 'The inequalities in the moon's motion due to the direct action of the planets.' The essays must be sent to the vice-chancellor on or before December 16, 1906. The value of the prize is about £225.

The British Ornithologists' Club has started an inquiry into the migration of birds. Information will be gathered from the keepers of lighthouses and lightships on the southern and eastern coasts of England, and information from observers in each county of England and Wales.

The New York State Commissioner of Agriclulture Weiting has submitted to the senate a report on the operation of the pure food law. With the appropriation of $10,000, voted in 1904, the department has examined 780 samples of food and discovered 134 violations of the statute, sixty-four of which have been referred to the attorney general for prosecution.

Through the courtesy of the Hydrographic Office of the Navy Department, and more particularly of Captain H. M. Hodges, hydrographer, and Mr. George W. Littlehales, the *National Geographic Magazine,* of Washington, D. C., publishes as a supplement to the February number a chart of the world on Mercator's projection, showing the submarine cable lines and their connections and ocean routes. Cable and telegraph lines are printed in red and ocean routes in blue. The latest cable lines are shown—as, for instance, the Alaskan cables of the U. S. Signal Corps and the wireless connection across Norton Sound. The tables of distances printed on the bottom of the chart will be found convenient. One table tells at a glance the comparative distances of New York and Shanghai, or Yokohama by the Panama, Suez and Cape of Good Hope routes. Another table gives the distances of our Gulf ports from the Atlantic end of the Panama Canal (Colon), and also from each other. The chart can be detached from the magazine and hung on the wall for more convenient use.

The British Medical Journal states that Professors Czerny, Erb, Hegar, Baumler and other distinguished representatives of medical science have lately with sanction of the government of the Grand Duchy of Baden, formed a committee at Karlsruhe with the object of discovering means of effectively combating the increase of cancer. On the proposal of Professor Czerny, who is the chairman of the committee, it has been decided to issue a circular to medical practitioners for the purpose of collecting complete statistics as to cancer cases occurring within the duchy. The cases will then be fully investigated. Special attention will be given to the question of the possible connection of cancer with local causes, its regional distribution, and the relative frequency of its occurrence among persons of various occupations. On the basis of information thus obtained it is hoped that it may be possible to devise measures which may check the spread of the disease.

The report of progress of stream measurements for the calendar year 1903 has been published by the U. S. Geological Survey in four parts, all of which are now available. During 1903 the number of regular stations for stream measurements was steadily increased, so that at the close of the year systematic measurements were being taken at 521 stations. These are so distributed as to cover the needs of the various states and territories. New York stands at the head of the list, with 70 stations, Colorado comes next with 34, California follows with 32, Michigan has 25, Montana 20, Georgia 18, Texas and Wyoming each 17, Washington 16, Kansas 15, and all the other states less. Oklahoma has only 2 stations, the least number in any state or territory, and Indiana, Mississippi and New Hampshire claim only 3 apiece. This expansion of the work is the result of the constantly increasing demand from the general and the engineering public for the stream data collected by the survey.

UNIVERSITY AND EDUCATIONAL NEWS.

It is said that the late James C. Carter, the eminent New York lawyer, has bequeathed $200,000 to Harvard University.

It is reported that Mr. Andrew Carnegie has offered to give $500,000 to the University of Virginia on the condition that the authorities of the institution raise a similar amount from other sources.

The Board of Trustees of Princeton University has appointed a committee of fifty to raise an endowment fund of $2,500,000. The purpose is to establish a tutorial system which President Woodrow Wilson has advocated for some time past. Mr. Cleveland H. Dodge, '79, of New York, is chairman of the committee.

Comptroller Grout has announced that a bill will be introduced at Albany incorporating a University of Brooklyn. It is proposed to give the university land owned by the city and to make an appropriation for building and equipment. The plan is to unite in the university the Brooklyn Institute, the Public Library, the Polytechnic Institute, Adelphi College, the Packer Institute and the Long Island Medical College.

Plans are being drawn for the erection of five new buildings for the School of Education, the University High School and the Chicago Manual Training School at the University of Chicago. The buildings will contain a workshop, an assembly hall, a museum, gymnasium and a hall for recitation purposes. Ground has been reserved for them in the School of Education group. It is expected that the total cost will reach $1,000,000.

At the first of the winter convocations of the George Washington University on Washington's Birthday, a gift of property, estimated to be worth $100,000, was announced for the establishment of a chair and course of graduate study on the history of civilization. The name of the donor is withheld for the present. Various sums of money raised by the trustees and alumni association, aggregating $275,000, were also announced.

The Mercers Company has voted a sum of £1,000 for the promotion of the study of physiology at University College, London.

A Blue-book has been issued containing reports from the fourteen colleges which participated during the year ended March 31, 1904, in the annual grant, amounting to £27,000, made by the British Parliament for 'University Colleges in Great Britain,' and from the three colleges in Wales, which receive a grant of £4,000 each.

The senate of Durham University has decided that German may be offered as an alternative subject for Greek in the preliminary examination for the degrees of doctor in medicine and master in surgery.

Dr. Brachet, of Liège, has been appointed professor of anatomy in the University of Brussels.

Professor N. J. Andrusson, of the University of Dorpat, has been appointed professor of paleontology and geology at the University of Kiew.

Dr. R. Credner, of Greifswald, has been called to Breslau as professor of geography.

SCIENCE

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SCIENCE

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FRIDAY, MARCH 10, 1905.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*THE MODERN 'DROIT D'AUBAINE.'**

ONE of the dark spots in the dark and middle ages is the treatment of foreigners. Was a ship wrecked upon the French coast? What was saved was saved for the seigneur who owned the shore, or his overlord, the king. The lading and the crew were alike his, to dispose of as he would. If the sailors were uncivil enough to set up a claim to the wreckage, he could kill them. If he preferred, he could sell them as slaves. It was his right—the *droit de naufrage*.

It was on the same principle that down to modern times, if a man happened to die while traveling or living abroad, his estate, in many countries of Europe, was seized and kept by the lord of the manor or the sovereign of the land. His will was disregarded. His natural heirs, unless born on the soil or naturalized citizens, were set aside. All that he left belonged to the governing power.

Quite naturally, as trade between nations became more considerable, the countries which retained this *droit d'aubaine* in its full vigor and severity found few merchants ready to bring cargoes to their ports. The result was successive modifications of the system. Certain trading centers were exempted from its operation. Naturalization was to be easily had by traders, and when obtained relieved them from subjec-

* Address of the vice-president and chairman of Section I., American Association for the Advancement of Science, at Philadelphia.

tion to it. Government securities held by any foreigners passed to their natural successors or by will.*

The interest of the government called for such relaxations of its so-called right, and the king who relaxed it most, because he saw most clearly that it was for his advantage so to do, found the foreign trade of his dominions grow most rapidly and settle itself upon the most stable footing.

The *droit de naufrage* was the first to disappear. The humaner law of the Christian emperors of Rome,† followed by the Visigoths in Spain in the seventh century,‡ and enforced in the twelfth by the laws of Oleron, appealed successfully to the awakening conscience of the modern world.

Anything in the nature of a *droit d'aubaine* had also been denounced in the *Corpus Juris* of Roman law.|| As time went on, its range became more and more contracted, and by the close of the middle ages it had become, so far as personal property was concerned, generally softened in practise to what was called a *jus detractus*,¶ except in case of those dying intestate and without known heirs.

As respects real estate in one country owned by citizens of another the sovereign of the former might still claim it as his own; but it was because political considerations were deemed to require it. In a nation whose constitution of government or family institutions rest on a landed electorate or aristocracy, it is right to debar foreigners from holding what might

* Merlin, 'Répertoire de Jurisprudence,' Aubaine, No. VII.

† Code, XI., iii., 5, *de naufragiis*, 1. Cf. Digest, XLIX., xv., *de captivis et de postliminio*, 5, 2.

‡ V., 5, *Corpus Juris Germanici*, 2001.

§ Art. 25, 26. 1 Peters' Admiralty Decisions, xli., note.

|| Code, VI., lix., *Communia de Successionibus*, 10.

¶ Fiore, Droit International Privé, I., Preliminaries, ch. II.

enable them to influence directly the conduct of government. This is the defence of the system of escheats under the common law of England, abolished there in 1870,* but which still lingers on in many of the United States.

It took the flames of revolution to burn the *droit d'aubaine* out of the institutions of France, and for a time, under Napoleon, it was restored as respects citizens of any nation which yet might retain it.†

Under the *jus detractus*, the sovereign within whose dominions a foreigner chanced to die no longer claimed title to all his goods, unless no will and no next of kin were anywhere to be found.‡ He was content with part, and, after making this 'detraction,' or, as we should say, 'subtraction,' gave up the rest to the natural heirs, or those to whom it might have been bequeathed by will.

So if a subject of his own should die, leaving a will in favor of foreigners, or having only foreign heirs, they were admitted to the succession, subject to a detraction of the same kind.

The percentages retained, in either case, as time went on, became more and more moderate. Reciprocal conventions between different nations for their regulation in this respect were not uncommon. Five

* With a proviso that an alien acquiring land should gain no political rights thereby.

† Civil Code, Arts. 726, 912; Law of July 14, 1819.

‡ If there be no better claim, that of the sovereign within whose territory property left by the dead is found is clearly good. The leading powers of continental Europe at their Conference held at the Hague in 1904, agreed (subject to the principle of reciprocity) to the mutual recognition of this right and the denial of any other in the nature of escheat or *aubaine*. 'Projet d'un Convention sur les conflits de lois en matière de succession et de testaments,' Art. II., *Revue de Droit International Privé*, VI., 348. Sixteen European powers and also Japan agreed to and signed this project, June 7, 1904.

per cent., which was the duty imposed in the first inheritance tax law of Rome—the *vicesima hereditatum et legatorum* decreed by Augustus—became not an unusual rate to fix by such an agreement in the latter half of the eighteenth century.*

So far as concerns such a tax on foreigners who come to take away what forms part of the wealth of a nation, it is, if the rate be moderate, in no sense inequitable. But for one sovereign to tax what belongs to the wealth of another bears a different aspect. It is the *droit d'aubaine* in a new dress and a politer form. It even asserts itself over a larger field.

The ancient *droit d'aubaine* was exerted almost exclusively in the case of foreigners dying within the realm; never except over tangible property found within it, belonging to their estates. The modern *droit d'aubaine* fastens upon all their property so found, whether tangible or intangible, and this whether they died within the realm or in their own country, out of which, perhaps, they had never set foot.

In the first of the treaties of the United States with foreign powers their right to do even this, with respect to estate left within their jurisdiction by an American citizen, was excluded, provided a reciprocal exemption were assured in return. This was that negotiated with France in 1778 (and abrogated by Congress in 1798), Art. XI. of which read thus:

> The subjects and inhabitants of the said United States, or any one of them, shall not be reputed aubains in France, and consequently shall be exempted from the droit d'aubaine, or other similar duty, under what name soever. They may by testament, donation, or otherwise, dispose of their goods, moveable and immovable, in favour of such persons as to them shall seem good, and their heirs, subjects of the said United States, residing whether in France or elsewhere, may succeed them ab intestat, without being obliged to obtain letters of naturalization, and without having the effect of this concession contested or impeded under pretext of any rights or prerogative of provinces, cities, or private persons; and the said heirs, whether such by particular title, or ab intestat shall be exempt from all duty called droit de detraction or other duty of the same king, saving nevertheless the local rights or duties as much and as long as similar ones are not established by the United States, or any of them. The subjects of the Most Christian King shall enjoy on their part, in all the dominions of the said States, an entire and perfect reciprocity relative to the stipulations contained in the present article but it is at the same time agreed that its contents shall not affect the laws made, or that may be made hereafter in France against emigrations, which shall remain in all their force and vigour, and the United States on their part, or any of them, shall be at liberty to enact such laws relative to that matter as to them shall seem proper.*

Among our later treaties with like or broader provisions may be mentioned those with Sweden of 1783, with Würtemberg of 1844, with Saxony of 1845,† with France of 1853, with Germany of 1876 and with Great Britain of 1900. The exemptions secured by those of the older type related only to property left in or subject to the control of one country by citizens of the other, at the time of their decease. They did not extend to interests of citizens of one in succession to estates of citizens of the other, which are in course of administration in the courts of the latter.‡ The later conventions do extend to these.§

The provision in the Constitution of the United States, securing to citizens of one state the ordinary privileges common to citizens of any other into which they may go, gives to our people a somewhat similar measure of security. But it has not prevented the building up, slowly at first, rapidly of late, of a network of state tax-

* See Merlin, 'Répertoire de Jurisprudence,' Détraction.

* 2 U. S. Rev. Stat., 206.

† *Ibid.*, 723, 809, 690.

‡ Frederickson *v.* Louisiana, 23 Howard's Reports, 445.

§ Geofroy *v.* Riggs, 133 United States Reports, 258.

laws, imposing succession duties on property left within the state by deceased citizens of other states, without regard to whether their representatives have already paid similar duties at home, and so are subjected to a double burden for a single privilege.

Within limits no economist will question the propriety of laying taxes on bequests and inheritances. They are collected with ease and reasonable certainty. They fall upon something which the taxpayer has never yet enjoyed and the diminution of which he therefore does not fully miss. The goose, to follow Colbert's maxim, is plucked so as to get the most feathers with the least squealing, and almost with none. Live goose feathers, indeed, are not required. The real victim is dead.

As to whether the form to be preferred is that of a probate duty, a stamp duty, a tax on the privilege of transmission, or a tax on the privilege of receiving what is transmitted, opinions may fairly differ.

Death duties were first imposed in Great Britain towards the close of the eighteenth century. Under the system developed there the movable property, wherever situated, of a person dying domiciled in the kingdom is subject to them, but not such property left in the kingdom by one who died domiciled in any other country.*

What is taxed is not the interest in property to which some person succeeds because of the death of its former owner, and not property at all, but the interest in property which the former owner lost upon his death and which would have ceased to exist altogether had not the state seen fit to prolong it in favor of those whom it recognizes as entitled to the succession.

It is this prolongation or revival of an estate which death has destroyed—a prolongation by force of no natural law, but only of the will of the political sovereign, that justifies a succession tax.*

The earliest American succession duties were levied by Congress in 1797, and took the form of a stamp tax on receipts for legacies.

Pennsylvania was the first state to impose them. She did this in 1826, but the law did not extend to goods of those not inhabitants of the state, which had been temporarily left there.† They were left untouched, in deference to the ancient maxim of private international law, *mobilia personam sequuntur*.

It was this maxim that had always been the chief measure of the jurisdiction of courts over the settlement of the estates of the dead. The estate had been treated as a kind of a survival of the person who once held and administered it. It therefore had its principal seat in the place which had been his home. Transfers of goods *inter vivos*, founded on contract, may be regulated by the law of the place of transfer; but transfers of the whole of a man's goods, upon his death, by force or permission of law, must, in fairness to all concerned, be regulated by the law to which he was subject. In England and America it is settled that this is the law of his domicil.

Those to whom that law gives them acquire a good title the world over. There is but one succession to a dead man's goods, and that takes place once for all when he dies and where he dwelt.‡ This law, which protected him while they were his, and

* Cross *v.* United States Trust Co., 131 N. Y. 643. As to probate duties, the statutes make a different provision. Fernandes' Executors' Case, 5 Chancery Appeals, 314.

* Orcutt's Appeal, 97 Pa. State Reports, 179.

† Knowlton *v.* Moore, 178 U. S. Reports, 41, 49, 55.

‡ Wharton's Private International Law, §§ 80, *a*, Reports, 330; 30 Northeastern Reporter, 125; Frothingham *v.* Shaw, 175 Mass. Reports, 59; 55 Northeastern Reporter, 623.

directs the course of their devolution when he is no more, may justly tax those who benefit by their devolution, irrespective of the place of their residence, or of that where the goods may chance to be found.

Our American succession taxes, like those of England, are everywhere, when imposed by the state where the deceased had his home, measured by a percentage of the value of all his goods, wherever situated, and all his real estate situated within the state, subject to some exemption of moderate amount.

But during the last twenty or thirty years the states have begun to go farther and charge a like percentage on all goods of a non-resident, which may be subject to their power.

There is no legal objection to this.

It is not double taxation within the meaning of any constitutional prohibition. In law, double taxation occurs only when the same sovereign taxes the same thing twice. But aside from this, a law of the kind now in question does not tax the same thing which had been taxed before. The sovereign of the domicile only can tax the succession to goods, because the succession takes place, once for all, under his laws and in his territory. What the sovereign of the *situs* of goods left by a foreign decedent taxes is not the succession to them, and not the goods themselves, but the privilege of taking them away, under the title derived from that succession.* The title is unquestionable, and unquestioned, but the right of the owner to avail himself of it in foreign territory depends on the comity of the foreign sovereign, who if he permits a transfer can prescribe the terms.†

* Foelix, Droit International Privé, I., § 9.

† Magoun *v.* Illinois Trust and Savings Bank, 170 U. S. Reports, 283, 288; Dammert *v.* Osborn, 141 N. Y. Reports, 564; 35 Northeastern Reporter, 407.

Nor is a tax so imposed any infringement of the privileges and immunities of citizens of other states, for they are treated precisely as those of the state by authority of which the tax is laid.

It is an infringement of a maxim of private international law; but such maxims may be set aside by any political sovereign who thinks it for his interest to disregard them. Our courts, in the absence of legislation to the contrary, treat the doctrines of private international law as part of the common or unwritten law, but it is only in the absence of legislation to the contrary. A statute can always abrogate unwritten law.

Not only is it lawful, but in many cases it seems not unjust, for a sovereign to tax the succession on goods within his dominions, left by a foreigner. If they were not simply in transit, but had been there so long as to become part of the wealth of the realm and to share in the settled protection of the government, they were subject to taxation for it when the owner was alive; and as the new successors must come there for possession, and can only dispossess those in whose hands they may be left by force of this sovereign's laws, and if need be, by process from his courts, they can not seriously complain if he asserts a right to tax them for what they get.

So it is also in the case of intangible property when that has been long placed by the owner in the hands of agents in a foreign country to manage and invest.*

But while such successions can be taxed by a sovereign of the domicil and taxed again by the sovereign of the *situs*, it is quite another question whether they should be.

* New Orleans *v.* Stempel, 175 U. S. Reports, 309; *In re* Lewis' Estate, 203 Pa. State Reports, 211; 52 Atlantic Reporter, 205; *In re* Romaine, 127 N. Y. Reports, 88; 27 Northeastern Reporter, 759; 12 Lawyers' Reports Annotated, 401.

Had we adhered inflexibly to the universal maxim of ancient law—*mobilia personam sequuntur*—the results would unquestionably have been far better. Every state laying a succession tax lays as high a one as it deems best to impose. It selects a certain subject for taxation and presumably exacts all that it can fairly be made to yield. For another state to tax the same subject again, therefore, is to impose a heavier burden than it ought to bear.

If the state in which the decedent's estate is settled collects the only duty, and this were the universal rule, nothing in the long run could be lost by any other state. On the average one would profit as much as another by uniformity of rule. While every state would let the citizens of another withdraw the property of the dead untaxed from its territory, its own citizens, as heirs or legatees, would bring back with equal freedom property of the same kind from all the rest.

As a matter of fact and history our legislatures in this matter have claimed the benefit of the rule *mobilia personam sequuntur* whenever it served their purpose to invoke it, and set it aside whenever it served their purpose to disregard it.

The test of taxability, as respects a succession to intangible property of a non-resident, may be said to be this: Whatever may be its form, if it have a money value and, although it may be fully owned by and fully transferable by the successor, can not be enforced or converted into money contrary to the will of the person against whom the right of property exists, without coming into the state imposing the tax, then it is property within that state and taxable as such.*

If a citizen of Texas die, having money on deposit in a New York bank, a succession tax may be levied on it by New York as well as by Texas.* If he leave bonds in his box in the vaults of a New York Safe Deposit company, and they are due from a citizen or corporation of New York, both states can exact the same percentage on these. If the bonds are those of a person or corporation of a third state, they may be subject to three taxes. The state where he lived lays a succession tax on their full value because he was subject to its power. The state in which the bonds are deposited for safe-keeping lays a tax of the same, or perhaps greater amount, on their full value, because the bonds are in its hands, and it will not let them go without receiving it. The state where the debtor who signed the bonds belongs can also levy as large a tax, because it can refuse any remedy in its courts for their collection except on such terms as it may itself lay down. So in the case of corporation stocks, the shareholder's estate pays one succession tax to the state of which he was a citizen, and those who succeed to him pay another to the state chartering the corporation, and possibly a third to a state in which the stock certificates were kept;† for by holding on to them till such tax were paid it could put a serious obstacle in the way of their sale and transfer.

It is to be remembered also that there is no constitutional limit to the rate of taxation. In Holland in the eighteenth century, collateral successions falling to the remoter kindred were subject to a deduction

* *In re* Whiting's Estate, 150 N. Y. Reports, 27; 44 Northeastern Reporter, 715; 34 Lawyers' Reports Annotated, 322; 55 Am. States Reports, 640; *In re* Houdayer's Estate, 150 N. Y. Reports, 37; 44 Northeastern Reporter, 718; 34 Lawyers' Reports Annotated, 235; 55 Am. State Reports, 642; Buck *v.* Beach Indiana Reports, 71 Northeastern Reporter, 962.

* Blackstone *v.* Miller, 188 U. S. Reports, 189.

† *In re* Bronson, 150 N. Y. Reports, 1; 44 Northeastern Reporter, 707.

in favor of the state of thirty per cent.* Three such taxes would leave of the oyster little but the shell.

In 1898, during the war with Spain, Congress also levied an inheritance tax, and the burden or the succession was heavier still until the repeal of that measure a few years afterwards. It did not, however, apply to personal property here passing on the death of the owner to citizens of another country.†

The results of this condition of multiple taxation are rapidly becoming apparent.

Capitalists are beginning to center their investments at home. They prefer to put their money in domestic stocks and securities, for these, upon their death, will be taxable but once. They are inquiring in which states, out of their own, it is safest to make or maintain investments; that is, in which states there are either no inheritance-tax laws or no inequitable ones. They are organizing corporations, which never die, to hold their property. They are taking title jointly with their wives or children, so that death leaves the survivor the sole owner.

It has been said that a country should never tax anything of value which, if not taxed, would be likely to find its way there, and which, if taxed, would be able to escape from its power.‡

The American people are quick-witted. It will not take long for all of them to learn in which of the states they can and in which they can not do business without subjecting their property, in case of death, to what is practically double taxation.

Wall Street is to-day the financial center of a great stretch of American territory. The trust companies, the banks and the safety deposit vaults of New York City hold vast amounts of moneys, bonds and commercial paper belonging to residents of other states, who have left them there for security, or to use them for investment or reinvestment. Their owners are taxable on them where they live. Their estates are taxable on them there, if they die. Let those men once fully understand that their estates would be also taxable on them in New York, and it will not be long before their investments take a new shape or are put under different keeping.

An inheritance tax by a state upon what is left by its own inhabitants is right and just. It is right and just to place it upon real estate situated within its territory and belonging to an estate of a dead man. It may be not unfair and not impolitic to place it upon tangible personal property of such an estate which has been statedly kept within its territory, and on which no such tax is imposed in the state or country to which its former owner belonged. But to tax it twice; to wring from widow or children or creditors, who have already paid one inheritance tax to the state under whose laws the estate is in course of settlement, another of a like kind, if not unfair, is certainly impolitic. It contravenes the settled conceptions of private international law—conceptions that, through long ages of unbroken tradition, have worked their way into the popular mind and become identified with those of social justice and economic law.

> "Ein tiefer Sinn wohnt in den alten Bräuchen.
> Mann muss sie ehren."

According to these, the succession to a dead man's goods is to be determined by the law either of the country of which he was a citizen or of that—generally the same—in which he had his home; and through that law it is to be worked out to the last detail.

* Adam Smith, Wealth of Nations, III., Book V., 326.

† Eidman *v.* Martinez, 184 U. S. Reports, 578.

‡ See David A. Wells on Taxation, 'Cyclop. of Political Science,' *ad fin.*

As death comes but once to every man and is the one event on the happening of which the devolution of his estate takes place, so that devolution, to work justice, must, as far at least as his personal property may be concerned, follow one single course of law.

During the last few years the principal nations of continental Europe have held four successive conferences at The Hague, to regulate the rights of the citizens of each with respect to acts and transactions that may come under consideration in the courts of the rest. On several points they have reached a definite agreement, in the shape of reciprocal conventions, ratified by the leading powers. A new convention was proposed by the last conference, held in June, 1904, on the subject of succession to the dead. It secures its regulation according to the law of the country of which the former owner was a citizen or subject.

England and the United States have thus far adhered to the view that the law of the land in which he had his home should govern. But under either rule the same end is secured—unity of administration. A single succession is to be regulated by a single law.

Our new American practice must operate as a divisive force within the American Union.

It attacks the prosperity of the country at a vital point. The United States have grown great and rich because of the principle of absolute free trade between the states so far as anything in the nature of a tariff is concerned, and absolute free trade in all respects, except so far as Congress may see fit to legislate to the contrary. It was the change to this policy from that of the pre-constitutional era that made the United States a living nationality. Under the Articles of Confederation each of the thirteen equal sovereigns could tax and often did tax the products of the others. In May, 1784,* for instance, Connecticut laid a duty on all goods imported from any other state, except such as had been previously imported from abroad by a citizen of Connecticut for use or sale in Connecticut. This law was expressly made applicable even to the baggage of passengers arriving by water. To such legislation the Constitution of the United States opposed an effective bar, and in so doing benefited every state to the injury of none.

A recent statement from the Bureau of Statistics at Washington shows that the total value of the goods dealt in last year throughout the United States in their internal trade, based on what they cost the first consumer, was twenty-two billion dollars. This is nearly fifteen times as great as that of the goods which we export; nearly twice that of all the goods imported during the same year in international trade throughout the world, and more than twice that of the whole world's exports for the same period. Much of this home trade is purely domestic; but much also is trade between the states.

Anything which impedes the free transmission of money or moneyed securities from one state to another so far unstrings the sinews of this commerce between the states. To tax their transmission when they pass in a mass, by the event of the owner's death, is to create an impediment to their transmission by him during his life which the public are fast learning to regard as very serious.

This evil first arose during the closing years of the nineteenth century. How shall it be remedied in the twentieth?

Could Congress treat it as so far affecting commerce between the states (and with foreign nations, for the double burden falls often on foreign heirs and legatees) as to justify a statute of the United States pro-

* Statutes, Ed. 1784, 271.

viding that such a tax, as regards any one estate or any one item of property belonging to an estate, could be laid but once?

If so, it would be to advance the powers of the nation a step farther than they have ever yet gone, and weaken correspondingly the sovereignty of the states. If, on the other hand, Congress has no such power, does it not naturally lead to the conclusion that the states have? Certainly a remedy more in accordance with our constitutional traditions than an act of Congress would be concerted action to the same end by the states under the principle of reciprocity.

From the beginnings of American history, neighboring English colonies were accustomed, at times, to send delegates to mutual conferences on matters of common interest. When they became states, the same practise was continued. Agreements were made in such conventions while the Articles of Confederation were in force, affecting matters of importance, although some of the statesmen of the day viewed them with disfavor as contrary to the spirit of the confederated government and tending to disintegrate the Union.*

This led to the provision in the Constitution of the United States (Art. I., Sec. 10) that no state should ' enter into any Treaty Alliance or Confederation ' nor * * * ' without the consent of Congress * * * enter into any Agreement or Compact with another state or with a foreign power.'

The courts have construed these provisions so as to make them detract as little as may be from the sovereignty of the states.

Three principles may be considered as settled with regard to them:

1. They do not refer to any agreements not affecting the political relations of a state to another state or to the United States.* It was their object to prevent the formation of any combination of states that might encroach upon the supremacy of the United States.†

2. No agreement or compact between states is to be deemed of that nature, unless it is clearly such.‡

3. Agreements or compacts between states of a political nature, although made without asking or obtaining the consent of Congress are not invalid if Congress afterwards should ratify them.§

In practise the states from the first have regarded this section of the constitution as not precluding arrangements and agreements between any of them of a business character which they might deem of mutual advantage.

They have by concurrent grants of charters similar in form created interstate corporations, which are as much at home in one state as another, and have in each the same powers and rights under the same name and with the same members.||

Interstate commissions have been constituted by appointments made by neighboring states to ascertain and mark the boundary between them.¶

Statutes to promote freedom of intercourse and exchange of business between states, have been passed by one state in favor of non-residents, conditioned on the existence of like legislation in the state of which they may be citizens.

* ' Madison's Introduction to his Journal of the Federal Convention' (Scott's ed.), 47.

* Virginia *v.* Tennessee, 148 U. S. Reports, 503, 519.

† Williams *v.* Bruffy, 96 U. S. Reports, 176.

‡ Baltimore and Ohio R. R. Co. *v.* Harris, 12 Wallace's Reports, 65, 82.

§ Green *v.* Biddle, 8 Wheaton's Reports, 1. Cf. 21 U. S. Statutes at Large, 351; Wharton *v.* Wise, 153 U. S. Reports, 155.

|| Two Centuries' Growth of American Law, 279; Graham *v.* Boston, Hartford and Erie R. R. Co., 118 U. S. Reports, 169, 170; 'Report of the American Historical Association for 1902,' I., 268.

¶ ' Papers of the New Haven Colony Historical Society,' III., 284, 286.

Since the introduction of automobiles statutes have been passed in some states requiring them to be registered and numbered, and the number, with the first letter of the name of the state, to be displayed on the vehicle, but with a provision that this shall not apply to automobiles coming into the state from another in which they have been registered and numbered under a similar law, and which make a similar display of the letter and number required there.*

Foreign insurance companies are often prohibited by statute from entering a state to do business, unless they fulfill certain prerequisites, with an exception in favor of those coming from a state or country where no such conditions are exacted from companies of the state enacting such statute.† So they are often subjected to certain taxes or fees, if and only so long as such taxes or fees are required by the state of their charter from companies created by the state by which the statute is passed.‡

Reciprocity with reference to foreign countries is also a feature of some of our state statutes for the removal of the common law disability to hold real estate. It is removed as respects citizens of countries imposing no such disability on American citizens who may seek to acquire lands within their jurisdiction.§

Statutes have been passed by one state to promote the administration of justice in certain others, or in all others, on conditions of reciprocal legislation on their part.

Thus in the first half of the nineteenth century New Hampshire enacted a statute to the effect that if one of her inhabitants were wanted in any other state as a witness for the prosecution in a case of felony, a subpœna requiring him to repair thither to testify at the trial might issue from a New Hampshire court on the request of the judicial authorities of the other state. Proper compensation for the expenses of the journey was to be tendered, and if, after such tender to the person whose presence was desired, he failed to appear at the trial, he was to be liable to a forfeiture of $300. Maine then adopted a similar statute except that it applied only to prosecutions pending in a New England state. Massachusetts followed in the same line, except that she confined the remedy to neighboring states, and to Maine, and in 1902 New York did the same with respect to bordering states, but on condition of the enactment on their part of reciprocal legislation of similar effect. Connecticut and Pennsylvania have since passed laws on this subject of the same general purport.*

In some similar way the states of the United States may yet come to a mutual understanding, and reciprocal justice become the rule in dealing with successions, whether by will or by inheritance.

A suggestion to that end was made in 1901 by the Buffalo Conference on Taxation. This body, composed of representatives of about thirty states, appointed by their respective governors, unanimously adopted this resolution:

> Whereas, modern industry has overstepped the bounds of any one State, and commercial interests are no longer confined to merely local interests; and whereas, the problem of just taxation can not be solved without considering the mutual relations of contiguous states; be it

* 'Public Acts of Connecticut,' 1903, 73.

† See 'General Statutes of Connecticut,' §§ 3,508, 3,544, 3,652.

‡ 'Public Statutes of Rhode Island,' Rev. of 1882, p. 396, Sec. 396; 'New York Revised Statutes,' 9th ed., II., 1146.

§ See 'Texas Civil Statutes,' I., Art. 9 (a statute passed in 1854).

* 'Public Statutes of New Hampshire,' ed. 1842, p. 382; of Maine, ed. 1871, p. 876; of Mass., ed. 1882, p. 986. 'Public Acts of Connecticut,' 1903, 57; 'General Laws of N. Y.,' 1902, p. 328.

Resolved, That this conference recommend to the states the recognition and enforcement of the principles of interstate comity in taxation. These principles require that the same property should not be taxed at the same time by two state jurisdictions, and to this end that if the title deeds or other paper evidences of the ownership of property, or of an interest in property are taxed, they shall be taxed at the *situs* of the property, and not elsewhere. These principles should also be applied to any tax upon the transfer of property in expectation of death, or by will, or under the laws regulating the distribution of property in case of intestacy.*

The Massachusetts Tax Commission in 1897 reported a bill to carry out the same principle, though on somewhat different lines.†

Machinery to facilitate a concert of action for the accomplishment of some such result, has for some years been in existence and active operation. This is the annual Conference of Commissioners of States on Uniform Legislation, held in connection with the meetings of the American Bar Association, and now representing a large majority of all the states. Its office is to frame and recommend to the states for adoption bills for suitable laws on subjects of common concern which ought to be regulated everywhere in the same way. The result of its labors may be seen in the existence of identical laws in the statute books of a number of states, which have been adopted on its initiative, the most conspicuous instance being that of the Negotiable Instruments Act.

It may well be doubted whether the form of reciprocity recommended by the Buffalo Conference is the best. It is not that naturally suggested by the Anglo-American rules of private international law. These would favor adhesion to the law of the state where the succession occurred—that of the last domicil of the deceased owner. On the other hand, the plan so proposed might be more answerable to the demands of modern society. It would serve to pay for protection to property actually received, in contradistinction from protection theoretically imputed.

But the only question to which the limits of an address like this permit me to call your attention is the larger one of the possibility and expediency of any reciprocal arrangements looking in this direction.

Could they or could they not be regarded as varying the public relations of the states concerned? Would or would not each stand towards the other in the attitude of a favored nation, since its citizens would be freed from a burden remaining upon those of other states? Is or is not a statutory grant of an exemption from taxation in favor of those belonging to another sovereignty, conditioned on the concession of a similar privilege by the latter to the citizens of the state enacting the first statute, and followed by such a concession, in substance a political compact between the enacting powers?

If there be any such constitutional bar, it could be easily removed.

The arrangement could hardly be deemed to stand on the footing of a treaty, alliance, or confederation. If not that, the consent of Congress would avoid any possible objection. There is no reason to doubt that this would be gladly given. Congress could hardly fail to welcome any proposition from states, looking towards concurrent legislation of the description named. Not only would it remove what is not unlikely to prove a serious impediment to free commercial intercourse between the states, but it would remove it in the interest of fair dealing and equal rights.

It may be suggested that even with the authority of Congress no such exclusive reciprocity could be established between two states by reason of the further constitutional provision (Art. IV., Sec. 2) that

* 'Judson on Taxation,' p. 547 note.

† 'Report of the Commission,' p. 191.

the citizens of each state shall enjoy the privileges and immunities of citizens in the several states.

The purpose of this section, however, is to prevent discrimination by one state against the citizens of another. Can it be said that a statute makes such a discrimination if it leave them entitled to the same privileges and immunities as those possessed by the citizens of the state making the enactment? The citizens of that state being required to pay a succession tax, can the citizens of another state, coming there to receive an inheritance or bequest, complain if they are subjected to the same burden, even if those of a third state may not be?* Is not the discrimination which the constitution prohibits one in favor of residents against non-residents, rather than one between non-residents who are citizens of different states?

The supreme court of the United States in 1831 had before it a cause which showed the complications as to state sovereignty over dead men's estates existing even under the established principles of private international law. A citizen of Virginia died in Pennsylvania, leaving personal property in the District of Columbia. A local administrator was appointed in Washington, and the question was whether the local law there or the law of Virginia should govern the distribution of the Washington assets. The court held that as the District of Columbia had the fund in its power, its law must control its disposition. "Whether," it added in its opinion, "it would or would not be politic to establish a different rule by a convention of the states, under constitutional sanction, is not a question for our consideration. But such an arrangement could only be carried into effect by a reciprocal relinquishment of the right of granting administration to the country of the domicil of the deceased exclusively, and the mutual concession of the right to the administrator so constituted to prosecute suits everywhere in virtue of the power so locally granted him; both of which concessions would most materially interfere with the exercise of sovereign right, as at present generally asserted and exercised."*

The convention here suggested, no doubt, was one to be called by Congress, under Article V. of the constitution of the United States, to propose amendments to it. There had then been but one instance of the convocation of any other kind of convention of representatives of states since 1789. That was the Hartford Convention of 1814, of delegates from three states, and it had been generally and unsparingly denounced as an unconstitutional assemblage for illegal purposes.†

Since that time, however, another of a more imposing character, and equally political in its objects, has been held at Washington—the peace convention of 1861—in which twenty-one states participated, and which was officially recognized by the president of the United States. The public were satisfied that this body accomplished a useful work in bridging over the passage of power from one party to another at a time when every day of continued peace was of the highest national importance, and although its right to act or indeed to exist was vigorously denied upon the floor by some of its own members,‡ the verdict of history must be in its favor.

Since then, besides many conferences or conventions from time to time of representatives of states under executive appoint-

* Paul *v.* Virginia, 8 Wallace's Reports 168, 180; Blake *v.* McClung, 172 U. S. Reports, 239, 248, 257.

* Smith, Adm'r *v.* Union Bank of Georgetown, 5 Peters' Reports, 518, 526.

† Adams, 'New England Federalism,' 245, 256.

‡ 'Debates and Proceedings of the Peace Convention of 1861,' 129, 134, 415.

ment, the National Conference of Commissioners on Uniform Legislation, to which reference has been made, has become a standing institution of unquestioned authority. That authority, indeed, is only to deliberate and to recommend. It makes no agreements between states. But it does initiate action by the states, through which, on some points, they are brought by the legislative action of each into a position of agreement.

Should it be able to agree on the recommendation of a definite, equal and consistent policy as to the subject which has been under our consideration, expressed in the form of an identical statute for general adoption in each of the states which it represents, it is not impossible that, one after another, the states would fall into line and follow the plan proposed.*

The tendencies of the time make for such a movement. Individualism and state-isolation are each giving way at every point of material contact to collectivism. The time-spirit and the world-politics of the twentieth century alike point to reciprocal governmental action on a great scale, for the prevention of international or interstate complications and collisions, as the true basis of national prosperity.

Simeon E. Baldwin.

* One state has already made a move in this direction. Connecticut prior to 1903 had not taxed goods of non-resident decedents by means of a succession duty. In 1903 she laid such a tax on them, but with a waiver of its enforcement in case of a succession to decedents belonging to a state or country not exacting such a duty upon personal property left within its jurisdiction by Connecticut decedents. Public Acts of Conn. for 1903, 43, Sec. 2. Gallup's Appeal, 76 Conn. Reports, 627; 57 Atlantic Reporter, 699.

PROCEEDINGS OF THE AMERICAN SOCIETY OF ZOOLOGISTS. SECOND ANNUAL MEETING OF THE EASTERN BRANCH.

The second annual meeting of the Eastern Branch of the American Society of Zoologists and the fifteenth annual meeting of the society since its establishment as the American Morphological Society, was held in the laboratory of physiology and pathology, University of Pennsylvania, Philadelphia, Pa., on December 27, 28 and 29, 1904.

The committee on the invitation to the International Zoological Congress to meet in this country reported that a formal invitation signed by all the members of the joint committee was personally presented at the recent meeting of the congress in Berne by Dr. Charles S. Minot and Dr. Ch. Wardell Stiles, members of the committee. The congress voted unanimously to accept the invitation and to hold its next meeting in Boston during the month of August, 1907. The congress further elected Mr. Alexander Agassiz president of the congress for the Boston meeting, and agreed to intrust the general arrangements for the meeting to the representatives of the American Society of Zoologists. It was voted that the appointment of a committee to make the necessary arrangements be left with the executive committee of the Eastern Branch acting with the executive committee of the Central Branch of the society.

The committee on zoological requirements for admission to college presented its report, which was approved. This report was published in Science, N. S., Vol. XX., December 16, 1904, pages 850–853.

It was voted that the matter of the publication of proceedings and abstracts be referred to a committee composed of the retiring secretary and the newly elected president and secretary. The officers elected for the ensuing year and those with unexpired terms are as follows:

President—William E. Castle.

Vice-President—William Patten.

Secretary and Treasurer—Henry S. Pratt.

Additional Members of the Executive Committee—Hermon C. Bumpus, Herbert S. Jennings and Ethan A. Andrews.

The following are abstracts of papers presented at the meeting:

Correlation and Variation in the Honey Bee: Everett F. Phillips, University of Pennsylvania.

This work is a continuation of the work done by the writer with Dr. D. B. Casteel.* The usual statistical methods have been used and the material used was uniformly Italian stock, each lot numbering 500. Workers, drones from drone cells and drones from worker cells were examined and characters of the wings were measured, the veins m and m_2 and the hooks on the hind wing. In every character examined the drones showed the greater variability, although they come from parthenogenetic eggs, while the workers come from fertilized eggs. The abnormalities of venation are also more numerous in drones.

In preparation for this work two queens (sisters) were introduced to colonies of bees, one of which had no drone comb, while the other had. In both cases drones were produced in abundance. In the hive having only worker cells the drones showed a reduction of 9.13 per cent. in the mean of the character compared, showing that the size of the bee is influenced very greatly by the cell in which it grows. Since just such cases appear in nature, the variation is influenced greatly by environment. The same difference in the size of the cell occurs in the development of female eggs into workers or queens, but here a difference in the food also enters into the consideration.

Several correlations were computed and there is a high degree of symmetry of the two sides of the body but a very low correlation between fore and hind wings. The veins m and m_2 which join each other show no correlation.

* 'Comparative Variability of Drones and Workers of the Honey Bee,' *Biol. Bull.*, December, 1903, pp. 18–37.

The full tables and computed results of this work will be published elsewhere in the near future.

Correlation in Development: O. C. Glaser, Johns Hopkins University.

In the development of *Fasciolaria* a process of cannibalism takes place during which six or eight embryos swallow their less fortunate comrades, and all the unfertilized eggs in each capsule. A fully gorged cannibal may contain over 300 eggs. Correlated with this habit, which taxes to the utmost the assimilative and excretory powers, are the external kidneys. In addition to their activity as renal organs, they present two other correlations with cannibalism. In *Fulgur* they originate simultaneously with and behind the velum: in *Crepidula* they originate after the velum and behind it; but in *Fasciolaria,* probably because of the need for them, they originate before the velum appears. This earlier origin conditions a change in ultimate position, for being just below the place where the velum originates, this on growing latterly carries the excretory organs with it. Finally they hang down from its under surface. Thus cannibalism has affected the origin of these organs and the structure of the veliger.

Accessory excretory organs, and amitosis in the endoderm of the veliger are also correlated with cannibalism.

Why are so many eggs infertile? This seems to be due to ovogenetic processes. These may possibly be analogous to those occurring in the spermatogenesis of *Paludina,* for as *Fasciolaria* has 'oligopyrene' and 'eupyrene' spermatocytes which yield corresponding spermatozoa, it may also have 'oligopyrene' and 'eupyrene' ovocytes which would mature into corresponding eggs. If this prove true a far-reaching correlation exists between maturation and the whole life history.

Whether this particular correlation exist or not, *Fasciolaria* illustrates how remote processes may affect the life of an organism, and how habits, apparently so useless as the manufacture of infertile eggs and imperfect spermatozoa, may be perpetuated, since such habits may have indirect results which, like cannibalism, are useful to the species.

The 'Great Forceps' of the Lobster: FRANCIS H. HERRICK, Western Reserve University.

In the higher orders of crustacea the chief weapons of both attack and defense, as well as for rending the prey, are the pincers or 'forceps,' borne on the first pair of massive periopods. In both American and European species two types of claw are developed, irrespective of sex, on either the right or left sides, the more primitive *toothed* or *lock-forceps,* and the larger, secondarily modified *crushing claw.*

In a fuller paper I shall be able to offer for the first time a complete history of the curious periodic sequence (first noticed by Starr in 1898), which occurs in the spines of the toothed claw, and which is apparently unique among animals—as well as of the development of the two types of claw, their structure, physiology and the changes which ensue in molting.

In the more slender lock-forceps the teeth are arranged in a linear series, in periods of eight. About midway in the serrated margin of the 'hand' or larger joint is a stout displaced spine of the first order, which forms the 'lock' to the claw. Upon closing, the dactyle falls on this spur, and its teeth slide under those of the propodus. It is thus firmly locked in this position, so that no lateral motion is possible. To meet this adjustment the tips of the claw are bent so that the dactyle is overlapped; the spines of the two joints are further inclined in opposite directions and aligned in a reversed manner.

When perfect, the formula for each period is as follows: 1:4:3:4:2:4:3:4:= 8. About four periods occur between the tip of the claw and the lock spine. The primary spines (1) are the first to arise, and are consequently the oldest, as they are the largest in the series. The primary spines alone are developed as the first larval stage, and tend to increase in geometrical ratio, by the regular interpolation of new spines between those already formed, in a linear series. There is even a tendency to advance to the fourth progression, which if effected would give periods of sixteen. Spines of the second and third order begin to appear in the third larva, while in the fourth stage usually at least one eight-period series is developed.

During the larval stages tegumental glands open by capillary ducts on the proximal side of each spine, near its tip. The tips of the claws develop like setæ or 'hairs.'

At the fourth stage both large claws are similar and of the toothed type. Differentiation of the crushing claw begins at about the eighth molt, the large tubucles being formed by a fusion of periodic teeth.

The chelæ abound in tufts of tactile hairs, especially in early life, but show no other peculiar sense-organs. The 'fine meat' of the tips of the claws is a sponge-work of involuntary muscle-fibers, to which blood has access, and is adapted to meet the needs of the molting period, when great local changes in blood-pressure are demanded.

The periodic sequence of the teeth in the toothed type of claw may be regarded as of incidental significance only, in increasing the efficiency of a nicely adapted prehensile tool and weapon. Cases of symmetry which occasionally occur may represent a reversion to the primitive and larval type, in an incomplete stage in the reversal of asymmetry, and therefore concerned with regeneration, like the phenomena observed by Przibram in *Alpheus*.

Torsion in the Crustacean Limb: Francis H. Herrick, Western Reserve University.

In crayfishes and lobsters the dactyles of the great claws face, and, therefore, open inward and in a nearly horizontal plane, while the smaller chelæ open upward and outward in a plane which is nearly vertical. In the lobster at birth, however, the chelæ, legs, great and small, all have the same form and position, that is, the laterally compressed claws all open vertically with an inclination outward. It, therefore, follows that the position of the great 'forceps' has been reversed by a rotation through 90°, in consequence of which their inner or anterior faces have become their under sides. With crayfishes, in which the metamorphosis is far more abbreviated, the adult form is already acquired at birth, so we may infer that this change has occurred in the embryo, for otherwise we should have to assume that the ancestors of the crayfish possessed another type of claw, which is not the case.

In the crayfish about one quarter of the weight of the animal is represented by the great chelipeds, while the proportional weight in the lobster is one half. The acquisition of size and strength in these limbs, and in *Homarus* the remarkable differentiation into toothed and crushing forceps of right or left sides, have been attended by a permanent torsion, which has chiefly affected the carpodite or fifth point. As can be clearly shown, however, this twisting is entirely independent of the form or weight of the claw. Meanwhile the eight slender legs have remained stationary, retaining their larval form and position.

The rotation of the chela in the lobster is completed at the fourth molt, which marks the most striking leap in the history of development. The change is unquestionably of very ancient origin, and is probably older than autotomy, which precedes regeneration in certain limbs, since fusion of the second and third joints does not occur until after the fifth stage. It was already perfected during the Liassic period in the Erymoid crustacea, which are regarded as the direct ancestors of modern crayfishes and lobsters.

Torsion in the crustacean limb can not be explained on Lamarckian principles, since, owing to the peculiar structure of the segmented limb, with its fixed hinge joints, the muscles of a given segment can deliver only straight pulls on the next distal segment, which could not produce a torsion of the joint in which the muscles are lodged.

The theory of natural selection fares no better, for it is impossible to suppose that the torsion could have arisen gradually, through successive fractions of a degree, each position being more favorable than the last, and especially since in hundreds of crabs and prawns the claws open upward and outward. It seems more probable that the condition was acquired suddenly as a discontinuous variation, which has become adaptive in a minor degree.

The Growth of the Tail of the Japanese Long-tailed Fowl: C. B. Davenport, Station for Experimental Evolution, Cold Spring Harbor, N. Y.

A preliminary report on the anatomy of the tail of the fowl and the morphologic basis of the long tail. A comparison of the tails of two brothers, one of which has had the tail feathers regularly stroked, the other not.

A Problem in Degeneration: Charles B. Wilson, State Normal School, Westfield, Mass.

The group of parasitic copepods affords one of the very best opportunities for studying degeneration and the problems connected with it. For the phenomena are not exhibited here as isolated examples, but as a continuous series in which every step can be traced clearly. This, supplemented by a study of the life histories of the different species, gives a first knowledge of factors and conditions which aids greatly in the drawing of rational conclusions.

One of the problems is that which concerns the cause, or rather the causes of degeneration. Parasitism, while serving as a stimulus or ultimate cause, can not operate directly in producing degenerative changes. There must be other more immediate causes which operate in connection with it.

These immediate causes have been studied but very little; most writers are content with the mere statement that the disuse of a part or organ is what leads to its deterioration and ultimate loss. But evidently there must be some reason for the disuse, and then if its effects are to be permanent, and to go on accumulating until they result in the entire disappearance of the part, they must be capable of inheritance.

As a contribution towards the settlement of this and other vexed questions a careful study of the conditions and phenomena of degeneration has been undertaken in connection with the study of the morphology and habits of these parasites.

At present the study has extended over the family Argulidæ and the subfamily Caliginæ, with the following results:

1. The Argulidæ show no signs of degeneration; there are many modifications of organs in adaptation to new conditions, but nothing that could be called a deterioration. The reason for this is found in the fact that they do not carry their eggs in cases but deposit them upon some convenient surface. An act so important to the preservation of the species calls for a complete preservation of all the powers possessed by free-swimming forms.

2. Of the Caliginæ, some show as little evidence of degeneration as the Argulidæ, while others furnish excellent examples of it.

The first step in this degeneration is a loss of the lunule, or sucking disks, on the frontal plates. Many causes contribute to produce this effect. The eggs are carried in cases and so retard locomotion; they are aerated by the movements of the host and so do not require movement on the part of the female; the best food supply is situated where there is the best aeration, so there is no incentive to movement.

3. The second step in degeneration is the assumption of a fixed position; here again several causes may be found. The larvæ are attached to the host by a frontal filament and after maturing have no incentive for moving about. On the disappearance of the lunules the second antennæ and second maxillipeds are enlarged and their claws serve for attachment organs. Claws can not be attached and loosened readily, but when once fastened securely there is a tendency to retain the hold.

The driving in of the claws makes a wound and causes a flow of blood, the food of the parasite; it is easier to lacerate the old wound than it is to make a new one; and again the deeper the wound the more plentiful the blood-supply.

4. The third step in degeneration is the modification of some part or organ in consequence of the fixed position. For each of these changes there are separate causes.

Notes on the Development of the Gill in Mytilus: EDWARD L. RICE, Ohio Wesleyan University.

The early development of the gill of *Mytilus* was worked out by Lacaze-Duthiers in 1856. To his account of the development of the earlier filaments the present writer has nothing to add. As described, a papilla is formed, grows downward from the gill axis, and is reflexed on itself, giving rise to the familiar U-shaped filament.

Later filaments follow a very different scheme, there being no such bending of an originally simple filament. At the posterior end of the curiously curved gill axis a series of thin transverse ridges are developed. At first the edge of each ridge is entire; but growth is early checked in the center, so that the ridge is divided into two flat, rounded lobes, corresponding respectively to a filament of the outer and one of the inner gill plate. As each lobe elongates it becomes perforated at its proximal end, thus being resolved into the two branches of a U-shaped filament, identical in form with those first developed.

An interesting parallel is seen in the development of the interlamellar connections. The interlamellar connection, in its finished form, is a simple bar, containing a blood channel, and connecting the two branches of one filament. In an early stage of development the two branches of the filament are connected by a continuous plate of tissue, extending from the bend of the filament upward for a short distance. This stage is closely comparable with the adult condition in *Modiola* and *Arca*. Later a perforation appears in this plate, and the portion isolated above the perforation is transformed into the characteristic bar-like connection. The results derived from the study of isolated filaments have been confirmed by the study of sections.

The Effect of a Freezing Temperature on the Development of the Frog's Egg: T. H. Morgan, Columbia University.
No abstract.

Latent Characters and Reversion: W. E. Castle, Harvard University.

1. The coat of the wild guinea-pig contains at least two pigments, black and yellow, on the same hairs. In certain varieties of domesticated guinea-pigs occur (*a*) black only, (*b*) yellow only or (*c*) neither pigment (albino variety).

2. These color types obey Mendel's law in heredity. In the order named (wild, black, yellow, albino), each type dominates all which follow it and is recessive to all which precede.

3. A recessive character disappears when brought into the same zygote with the corresponding dominant, but reappears distinct in half the gametes formed by the hybrid zygote. Hence recessive characters may exist unseen in individuals apparently dominant, but are bound to reappear if hybrid dominants are bred *inter se*.

4. Dominant characters also may exist unseen in recessive individuals, but the conditions of their reappearance are quite different. Such unseen (not recessive) characters may be called *latent*. Mating of recessives which contain latent dominant characters ordinarily produces only recessive individuals. Cross breeding with the dominant type is usually necessary to bring latent characters into activity, though in some cases where the latency was partial only, cross-breeding of two different recessive stocks has accomplished this result.

5. Albino guinea-pigs, mice and rabbits, transmit *latent* specific pigment characters (as black or yellow). This can be demonstrated by cross-breeding. Smooth-coated guinea-pigs may contain, in a condition of almost if not complete latency, the dominant rough or rosetted coat.

6. Reversion (or atavism) is a name which has been given to the reappearance in a race of lost ancestral characters. The matter has always been more or less mysterious, but would seem to consist in large part, if not exclusively, in the becoming active of characters which are latent. For this process cross-breeding seems normally to be essential, its function being either to

stimulate dormant potentialities into activity, or to bring together the isolated elements of a character which in its complex form has been lost.

Artificial Parthenogenesis in Thalassema mellita: George Lefevre, University of Missouri.

An investigation of artificial parthenogenesis in *Thalassema mellita* has shown that the eggs of this worm can be induced to develop into actively swimming trochophores, in the absence of sperm, by immersion for a few minutes in very dilute solutions of acids both inorganic and organic. Nitric hydrochloric, sulphuric, carbonic, acetic and oxalic acids were used successfully, and in favorable experiments 50–60 per cent. of the eggs developed into swimming larvæ that could scarcely be distinguished from normal trochophores of a corresponding stage.

An egg membrane invariably forms shortly after removal from the acid solutions, and maturation, identical with the normal process, frequently occurs. In a number of cases, however, polar bodies were not extruded, but the eggs divided and eventually gave rise to trochophores without any external indication of maturation. On sectioning such eggs it has been determined that the maturation process occurs internally, the polar mitoses taking place below the surface and without accompanying cytoplasmic division. The result is that, in some cases at least, four resting nuclei are formed in the cytoplasm of the egg which represent the egg-nucleus and the nuclei of the three polar bodies. These four nuclei then come together and fuse to form a cleavage-nucleus, which, therefore, contains, in addition to the chromatin of the egg-nucleus, all the chromatin that would have passed into the polar bodies, had they been extruded.

The egg-centrosome disappears after the formation of the second polar body, and the cleavage-centrosomes arise *de novo*.

It has frequently been observed that the polar bodies continue to divide, with the result that they form a morula-like cluster of minute cells.

Cell-divisions take place mitotically, and in many cases the early cleavage is perfectly normal, although a great variety of abnormal cleavages also occur.

The larvæ arising parthenogenetically are strikingly normal in appearance and structure and exhibit the usual differentiations characteristic of the normal larvæ of a corresponding stage of development, digestive tract and mouth, prototrochal band, apical plate and flagella, etc.

Further Experiments on Self and Cross Fertilization in Ciona: T. H. Morgan, Columbia University. No abstract.

A Few Words on What is to be Understood by 'Good' Fixation: Alexander Petrunkevitch, Harvard University.

The question of what is to be understood by 'good' fixation is of both theoretical and practical value. Authors disagree as to how much of what we observe under the microscope is artefact and consequently as to the trustworthiness of the conclusion drawn from it. In my opinion, as fixed material consists in artefacts only, we should learn to eliminate errors by comparison. Two errors are especially to be shunned: mistaking for true, (1) structures which result from a dislocation of cell-organs, (2) those created by the use of injurious agents. Pauli placed the alveolar structure of protoplasm in the latter group, demonstrating that colloids show no separation into two 'phases' when a normal solution of urea is added to the fixing liquid. I repeated his experiments with a great variety of agents, some of them never used before. The results are the opposite of those obtained by Pauli.

A good fixing liquid ought to have the following qualities: (1) to produce no dislocations, (2) rapid penetration, (3) to cause no overhardening, (4) not to impair staining capacity.

As a fixing liquid for general use which fulfills these requirements I recommend the following mixture:

Alcohol absol.........	200
Water	300
Glac. acetic acid......	90
Nitric ac. pure conc...	10
Corrosive sublimate...	55 (saturated).

The objects are put in this liquid for a period of from 6 to 24 hours, then washed in 70 per cent. alcohol with iodine which must be frequently renewed; after this they can be kept indefinitely in 70 per cent. alcohol.

The Formation and Behavior of the Microzooids of Hæmatococcus pluvialis: Florence Peebles, Woman's College.

Under normal conditions the resting cells of *Hæmatococcus* produce more macrozooids than microzooids. If, however, the dead leaves and other objects upon which they live are subjected to frequent periods of rapid desiccation the number of microzooids formed is greatly increased. These microzooids can be obtained in large quantities if the mother cells are subjected, in the early stages of division, to cold and then suddenly changed to a warm temperature; or, if kept at first in the dark, and then placed in direct sunlight. They are positively heliotropic and gather in swarms on the side of the vessel that is nearest the light.

After escaping from the mother cell a microzooid swims about for twelve to forty-eight hours and then comes to rest, loses its flagella, develops a cell wall and begins to grow. After a day or two, the first cell wall is cast off and a new one forms. A large number of microzooids have four flagella, others two. These with four have exactly the same shape but are larger than those with two. Many double individuals have been observed, and these after a short time fuse into one normal spore. Although no two microzooids have been found in the first stage of conjugation, it seems highly probable that they are gametes, and that under certain conditions conjugation takes place, and that the zooids with four flagella are zygospores.

The Evolution of Color-producing Structures in Birds: R. M. Strong, University of Chicago.

The colors of feathers from between seven and eight hundred birds were studied. The causes of colors in feathers, the nature of color characters and the evolution of color in birds were considered.

The material studied argues strongly in favor of the orthogenetic theory of evolution of color pattern by continuous variation, advocated by Professor Whitman. A great many peculiar modifications in structure and pigmentation occur in birds. Some of these produce color phenomena which often seem, at first, to be unrelated to other colors found in birds. These studies have demonstrated, however, that a perfect continuity exists between color characters. Complete series of intergrading conditions occur in single feathers, at the margins of color areas, and in allied species.

Extreme developments, like the phenomenon of iridescence, occur very generally in bird feathers, but often in incipient stages not observable except with the aid of the microscope. Colors involving complete differentiations in structure and pigmentation sometimes appear in amounts too small to effect the total color impression received by the unaided eye. These color phenomena are ordinarily perceived only when they are produced by a large proportion of the feather elements for a given area on the feather.

New color characters first appear at the extreme distal end of the feather, and they may move proximally, encroaching upon other characters. Likewise new characters appear first at the distal ends of the barbules.

The History of the Germ-Cells in Pedicellina americana: Louis I. Dublin, Columbia University.

In this study the attempt was made to work out as fully as possible the history of both egg and sperm, with especial reference to the chromatin, and to compare this with the character of the chromosomes in the various somatic tissues—thus covering the entire life history of the individual. The number of chromosomes is twenty-two. These are, in the various somatic cells and in all but the last generation of oogonia and spermatogonia, distinct Vs in shape. In this last generation, however, the chromosomes are converted into rods and from the size relations, it is very probable that these have arisen through the extension of the angle in the preceding Vs to 180°. These rods split in the metaphase and passing to the poles give rise to eleven, or the reduced number of new Vs. From the rather full evidence, more particularly in the sperm history, it is beyond question that these new figures have arisen by the end to end union of the rods at the telophase of the last spermatogonial and oogonial divisions. This is for *Pedicellina* the true synapsis, and the conversion of the chromosome form from Vs to rods is in preparation for it, thus strikingly confirming the results of Montgomery and Sutton. The eleven loops thus formed grow rapidly, split longitudinally and then become extended into nearly straight thin parallel threads, the synaptic point being at the middle. The chromosomes now contract and form themselves into double rods, ellipses and rings, and as such enter into the first maturation spindle. From the complete history of the individual chromosomes up to this point and the ease with which the synaptic point may be followed this division is undoubtedly the reducing one, separating the chromosomes which had united at the synapsis. The second division is longitudinal and the maturation processes are completed.

Color Changes in Anolis: G. H. Parker and S. A. Starratt, Harvard University.

Anolis carolinensis, according to Carlton, changes in the dark from brown to green in about twenty-five minutes, and in the light from green to brown in about four minutes. Temperature, however, was found to influence this rate. Thus in the dark at 10° C. the lizards remained brown; at 20° they changed to green in about 20 minutes; at 25° in about 13 minutes; at 30° in about 11 minutes; at 35° in about 15 minutes; and at 40° and 45° they were always green. In the light at 10° they also remained brown; at 20° they turned brown in a little over 4 minutes; at 25° in about 3.5 minutes; at 30° in a little over 3 minutes; at 35° in about 2.8 minutes; and at 40° and 45° they were always green. Thus a low temperature induces brown and a high one green and both are independent of illumination.

The changes from green to brown and the reverse take place at temperatures where light is an effective stimulus when the lateral eyes and the pineal eye are artificially covered. A beam of light about a millimeter in diameter and thrown upon the skin is all that is necessary to induce the change from green to brown. The nerves of the skin of *Anolis* must, therefore, be sensitive to light.

Organ-forming Substances in the Eggs of Ascidians. Illustrated by Photomicro-

graphs of Living Eggs by Katharine Foot and Ella C. Strobell: Edwin G. Conklin, University of Pennsylvania.

Three very different kinds of protoplasm may be observed and photographed in the living ovocytes and unsegmented eggs of *Cynthia partita;* these are the yellow *mesoplasm* which later enters into the mesoderm, the gray *endoplasm* which gives rise to the endoderm, and the transparent *ectoplasm* which becomes ectoderm. Three additional differentiations are visible and have been photographed before or immediately after the first cleavage, viz., the mesoplasm is differentiated into a deep yellow substance, the *myoplasm,* which gives rise to the muscles of the larva and into a light yellow material, the *chymoplasm,* which becomes mesenchyme; there is also recognizable an area of light gray material, the *chorda-neuroplasm,* which develops into the chorda and neural plate of the larva.

As early as the close of the first cleavage all of these substances are localized in the egg in positions corresponding to those which they will occupy in the embryo or larva; the mesoplasm forms a yellow crescent around the posterior side of the egg dorsal to the equator, the chorda-neuroplasm takes the form of a gray crescent around the anterior half of the egg, the endoplasm lies between these two crescents at the dorsal (vegetal) pole of the egg, the ectoplasm occupies the ventral (animal) hemisphere. The dorsal border of the yellow crescent consists of light yellow protoplasm (chymoplasm), which gives rise to the mesenchyme of the trunk, while a similar area of light yellow or clear chymoplasm lies at the middle of the crescent behind and ultimately forms the caudal mesenchyme of the larva. All of these areas and substances can be followed with ease and certainty throughout the development until they enter into the principal organs of the larva, a fact which is beautifully shown by the photomicrographs.

Experimental Studies on the Ascidian Egg: Edwin G. Conklin, University of Pennsylvania.

That the various areas and substances of the ascidian egg are actually organ-forming ones may be demonstrated by experiment. Operations on the unsegmented egg inhibit development, but when certain blastomeres of the cleavage stages are killed or injured the ensuing development of the uninjured blastomeres is strictly partial; in no case do such blastomeres give rise to other organs than those which they would have produced under normal conditions. Conversely, if the cells which contain the myoplasm are destroyed the resulting larva has no muscle cells; if the cells containing the chorda-neuroplasm be removed there will be no chorda nor neural plate in the resulting monster; the same is also true of the ectoplasm and endoplasm.

Since all these substances are divided bilaterally at the first cleavage, each of the first two blastomeres contains one half of all of the organ-forming substances, and inasmuch as isolated blastomeres of the ascidian egg produce rounded masses of cells which tend to close over the injured part, it frequently happens that the half embryo or larva bears a superficial resemblance to a whole one; however, a study of their cell-lineage and later development shows that they are still half embryos and larvæ. When the egg is injured along any other plane than the median one nothing even remotely resembling a normal larva is ever produced.

Prophases of the First Maturation Spindle of Allolobophora fœtida: Katharine Foot and E. C. Strobell.

At the end of the growth period, the chromatin granules which are distributed throughout the germinal vesicle segregate into an extremely fine spireme. This spireme becomes shorter and thicker, and shows a distinct longitudinal split. It then divides *transversely* into eleven bivalent chromosomes, *i. e.,* in each case two univalent chromosomes remaining attached end to end. There is no conjugation of univalent chromosomes; it is merely a question of two univalent chromosomes already attached in the spireme remaining so, this causing the numerical reduction to half the somatic number.

The two univalent chromosomes of each of the eleven bivalent chromosomes are still attached end to end at the metaphase of the spindle, and the longitudinal split seen in the spireme of the earlier stage persists until this period, causing typical tetrads, *i. e.,* bivalent chromosomes with a longitudinal and a transverse furrow. These chromosomes separate along the line of the *transverse* furrow (which indicates the point of attachment of two univalent chromosomes). *Allolobophora* thus supports the observations of Korschelt in the annelid *Ophryotrocha,* and Montgomery and others who maintain that the first division separates univalent chromosomes and is, therefore, a reducing division.

There are two nucleoli in each germinal vesicle, the relatively large *principal nucleolus,* and the smaller *accessory nucleolus,* and neither appears at any time to be a storehouse for the chromatin which forms the chromosomes. The principal nucleolus disappears before the spindle is formed, but the accessory nucleolus may persist until much later.

We interpret the accessory nucleolus as the precocious appearance of the nucleolus of the oocyte of the second order. If, as held by a number of investigators, the chromosomes of one division are in some manner related to the nucleolar substance of the following rest stage, may not this take place at an earlier period, and the accessory nucleoli of the germinal vesicle be a precocious appearance of the nucleoli, which are so conspicuously absent between the first and second maturation spindles, the processes involved in the rest stage occurring before instead of after the first division, and the origin and growth of the accessory nucleolus being part of them? The second division precociously foreshadowed in the four-part chromosome of the germinal vesicle suggests a precedent for this interpretation.

A Quantitative Study of Holothuria atra Jäger and the Reestablishment of Holothuria floridana Pourtalès (=Holothuria mexicana Ludwig): Charles Lincoln Edwards, Trinity College, Hartford, Conn.

Jäger, 1833, described *H. atra* from Celebes. Pourtalès, 1851, described *H. floridana* from Florida. Semper, 1868, gave *H. floridana* as a synonym of *H. atra* and since then all authors have followed Semper. Ludwig, 1875, described *H. mexicana.* Clark, 1901, gave Porto Rican specimens as *H. mexicana.* Ten of these specimens identified by Clark are included in my statistics and they are *H. floridana* as defined in this paper. Statistical analyses of 138 specimens, 20 from the Sandwich Island-Mozambique and 118 from the Florida-Caribbean region clearly demonstrate that *H. floridana* Pourtalès should be reestablished as a species distinct from *H. atra* Jäger, and that *H. mexicana* Ludwig is a synonym of *H. floridana.* In general, biometry offers a most important method in taxonomy for determining the extent of variation and, therefore, of the best (least variable) specific characters and their proper definition, together with the separation of growth from adult characters. The following comparison gives in brief résumé the chief differential characters:

H. atra.	*H. floridana* (= *H. mexicana*).
Color mostly uniform seal-brown.	Color very variable. Shades of brown like seal, clove, Vandyke, etc., and of gray, cream, huff, etc. Often beautifully marbled. Youug generally lighter.
'Pits' in skin. No 'warts.'	'Warts,' each a heap of spicules usually surmounted hy a conical papilla, generally present, especially in young. No 'pits.'
Skin flaccid. 1–1.5 mm. thick. 25 per cent. of dorsal ambulacral appendages are pedicels; the rest papillæ. 5 types of calcareous end-plates from large, well developed, associated with the cylindrical pedicels to small, vestigial with the conical papillæ.	Skin firm, 2–5 mm. thick. 80 per cent. of dorsal appendages are pedicels; of the remainder not all are true papillæ. Much larger percentage of well developed end-plates, only 1 case of the fourth and none of the fifth type.
Calcareous rosettes like crosses; central rod elongated. Longer, broader and more delicate.	Calcareous rosettes stellate; central rod short; branches blunt. Twice as thick as those of *H. atra.* Growth stages of the perforated plates.
Of 300 rosettes 2 had 3 holes, 4 had 2 holes and 19 had 1 hole. No well developed plates.	Special types of 4- and 8-hole plates, together with other incomplete plates, are growth stages of the fully developed plates which have 4–31 holes; mean 13–14 holes.

The number and length of polian vesicles and of stone-canals increase with age. Seventy-one per cent. of the young *H. floridana* have only 1 polian vesicle, while in the adult the number ranges from 1 to 92. The total number of stone-canals in *H. floridana* ranges in the young from 2 to 25; in the adult, from 5 to 149.

On Some Points in the Natural History of the Oyster: Ramsay Wright, University of Toronto.

The author, who has been directing the Marine Biological Station of Canada at Malpeque, Prince Edward Island, during the last two summers, exhibited some photographs in illustration of his paper. The first showed that the kidney is a much more conspicuous system of branched tubes, at least during the spawning season, than is generally supposed. The tubes extend into the pericardial wall, and into the mantle in the neighborhood thereof.

Photographs of the male and female genital ducts showed that it is possible in ripe individuals to recognize the sexes without examining the genital products. It was stated that while in oysters of three or four years' growth the sexes are equally divided, 90 per cent. of one year old oysters, which are already sexually mature, are males, a circumstance which seems to point to the protandry which has been asserted of the American oyster. A more exhaustive study of this point is required.

The occurrence of *Urastoma* (better, *Urostoma*) *cyprinæ*, Graff, a commensal turbellarian, was recorded from the oyster. It has hitherto been observed in *Cyprina islandica* from the Baltic, *Mytilus edulis* from the White Sea, and in *Solen vagina* from Trieste.

*Diversity in the Scutes and Bony Plates of Chelonia:** R. E. Coker, Johns Hopkins University.

I. *Scutes.*—There is a remarkable degree of diversity in the number and arrangement of the scutes of the carapace and plastron of certain species of Chelonia, notably *Malaclemmys centrata* (Latr.) and *Thalassochelys caretta* (L.). Of 244 specimens of *Malaclemmys,* 109 were abnormal in scutes; 20 per cent. had either more or less than the typical number of carapace scutes. About one half of the abnormal specimens were asymmetrical.

Neither in observations on *Malaclemmys* nor in those on 26 embryos from a single nest of *Thalassochelys,* was support found for Gadow's theory of 'orthogenetic variation.' For example, the embryos averaged, per carapace, a fraction less than the typical number of scutes.

Rare instances are found of a peculiar form of variation that may be termed 'orthogenetic.'

II. *Correlation.*—The normal correlation of scutes and plates is, roughly, a modified alternation, the alternation being especially simple in the marginal series. The corre-

* Presented with the permission of Hon. Geo. M. Bowers, U. S. Commissioner of Fish and Fisheries.

spondence of marginal plates with sutures between scutes is retained in several shells abnormal in the marginal region. In the costal series the seventh forms an exception: but it harmonizes with the others falling into the alternating series, and bearing the triradiate impression of scute sutures in several specimens that have a supernumerary neural in the posterior region. In shells abnormal as regards scutes, the normal condition of correlation may tend to be preserved by associated (correlated) abnormalities in bony plates.

The presence, in correlation with supernumerary scutes, of a ninth costal plate may be an atavism. In such cases observed, the tenth rib, instead of as normally anchylosing with the ninth rib and eighth costal plate, enters into the ninth costal plate; so that each dorsal rib, except the first, forms part of a plate.

More complete results, with drawings and photographs, are in preparation for publication.

On the Nature and Behavior of the Morphogenous Substances in the Egg of Chætopterus: Frank R. Lillie, University of Chicago.

Eggs of *Chætopterus* may be stimulated to undergo differentiation of certain kinds without the process of cleavage by a variety of methods. Such unsegmented ova develop cilia and swim about actively. The protoplasm is vacuolated like that of the normal larvæ and the yolk is aggregated in a manner resembling that in the normal development.

Careful examination of this mode of development, however produced, showed that it proceeds by the segregation and differentiation of substances readily distinguished by their optical properties and by their behavior. The sequence of events is somewhat obscured and complicated by amœboid movements of the protoplasm, but is essentially the same in all ova. Five separate substances may be readily distinguished, arranged like a series of strata, prior to the appearance of the cilia; one of these overflows the remainder and cilia develop from this layer alone, which is characterized by the presence of peculiar granules.

The same substances may be recognized in the normal unsegmented egg where they have a different arrangement, and they may be followed in the normal development. They thus appear to be specific in their morphogenic properties, both in the normal and in the modified development. Morphologically these substances are distinguishable only by differences in the size, arrangement and microchemical reactions of the larger spherules, and not at all by local differentiation of the microsomes or ground substance of the protoplasm. The conclusion appears inevitable that in *Chætopterus* at least, the differences between specific morphogenic substances are dependent, certainly in part, on the nature of the spherules contained.

The observations led to the conclusion that these spherules exhibit attractions and repulsions among themselves, which may, to a great extent, explain their segregation and arrangement.

The spherules have all been lumped together as 'yolk' in the egg of *Chætopterus*. In other animals, also, is the so-called yolk really a mixture of various substances? It is in any event certain that we have no precise criterion of yolk in holoblastic eggs, and one is badly needed.

The Structure of Bothriolepis, with Exhibition of Specimens of Devonian Fishes of Canada: William Patten, Dartmouth College.

This paper was based on a large collection of new material recently acquired by the author from New Brunswick. Numerous specimens illustrating the mode of life and especially the structure of the mouth-parts were exhibited.

The Color-Pattern of Nanemys guttata Schneider (a preliminary report): Robert M. Yerkes, Harvard University.

1. The young of this species of tortoise usually have a single yellow spot on each plate of the carapace, except the marginals. With age the number of spots increases, they appear on the marginal plates also, and their arrangement becomes irregular.

2. The epidermal layer is transparent immediately over the mass of yellow pigment in the outer bony layer, hence, window-like regions in the outer portion of the shell.

3. Although the females are slightly smaller than the males they usually have about 15 per cent. more spots on the carapace. The average number for the males is 60, for the females 69. This would seem to indicate that the brightly colored spots serve as both sex and species marks. Probably they serve to render the females conspicuous.

4. Statistics indicate a greater number of spots on the left side of the carapace than on the right in both males and females. It is possible that this is to be correlated with right-handedness and right-eyedness.

Chromosome Vesicles in the Maturation of Nudibranchs: W. M. Smallwood, Syracuse University.

Between the anaphase of the first maturation and the prophase of the second the chromosomes pass through some important changes. The first indication of the presence of vesicles is noted at about the time that the young amphiaster of the second maturation figure is forming and moving into a radial position. At this time a distinct membrane appears around each chromosome, which lies so close to the chromosome as to be overlooked in some instances. It frequently happens that one chromosome vesicle contains two or more chromosomes, in which case the chromosomes are united by narrow strands of chromatin.

The chromosomes do not always pass into vesicles, but go through the well-known changes as described for other molluscs, annelids, etc.

During the prophase of the second maturation the solid chromosomes enclosed in vesicles may lose their reaction to basic stains almost entirely, with the result that each vesicle represents in miniature a nucleus having chromatic granules, linin threads and an achromatic substance. After this condition the granule, or granules, within the chromosome vesicle increases in size until it has the normal appearance of a chromosome lying in the cytoplasm. It is an open question as to the fate of the surrounding vesicle.

The fibers constituting the second maturation spindle are formed in part of the eggs from the cytoplasm after the spindle has taken a radial position and the centrosomes are fully differentiated into centriole and centroplasm.

The chromosomes which pass into the first and second polar cells may each have a separate vesicle or all of the chromosomes may pass into one vesicle. All combinations between these two extremes occur.

These and similar results on *Haminea* suggest that the chromatin passes through a liquid state during maturation, at which time there may be a complete chemical rearrangement of the molecules in the chromosome, which, if it were true, would interfere to some extent with the theory of the qualitative division of the chromosomes.

The complete paper will appear in the *Morphologisches Jahrbuch*, Bd. XXXIII.

Experimental Studies of Adaptation and Selective Elimination in Fishes: Francis B. Sumner, College of the City of New York. No abstract.

Habits and Reactions of Crabs bearing Actinians in their Chelipeds: J. E. Duerden, University of Michigan.

Möbius in 1880 first made known the fact that the crab, *Melia tessellata* Latr., has the remarkable habit of carrying a living actinian in each claw. The polyps are carried about in front of the crab, held in a kind of defensive attitude, and it is assumed that the actinians, by means of their stinging threads, may be useful to the crab for purposes of offense and defense, while the activity of the crab may serve to bring the actinian into the neighborhood of more prey. During a recent visit of the writer to the Hawaiian Islands, under the auspices of the Carnegie Institution, two specimens of *Melia,* both bearing an actinian in each claw, were collected, and observations made upon their habits and reactions. These may be summarized as follows:

1. The commensalism is not restricted to a single species of actinian. One crab carried a *Bunodeopsis* and the other a Sagartid. The species are interchangeable, and the crabs will dislodge a small polyp to take up a larger. Apparently the crab is not aware of the presence of an actinian until it comes in actual contact with it; dislodgment of a fixed actinian is brought about by means of the first pair of ambulatory limbs.

2. When irritated the crab moves its chelipeds so as to place the actinians in such a position as to best serve as a means of defense. Food given the polyps is abstracted by the crab by means of its first pair of walking limbs, the stimulus to activity being probably derived from the diffusion of the meat juices.

3. *Melia* has lost the direct use of its chelipeds as organs of defense and offense, or for grasping objects other than the actinians; in correlation with this the functions of the first ambulatory appendages have become largely modified.

4. A second species of crab, *Polydectus,* was also found which bears an actinian, *Phellia,* in its chelipeds.

On the Structure of the Larval Oyster and its Occurrence in the Plankton: Joseph S. Stafford, McGill University. Read by title.

A Statistical Study of Correlation and Selection in Lepidoptera: Henry E. Crampton, Barnard College. Read by title.

Henry S. Pratt,
Secretary.

SCIENTIFIC BOOKS.

Vorlesungen über Pflanzenphysiologie. Ludwig Jost. Jena, Gustav Fischer. 1904. Pp. xiii + 695; 172 figures.

In the form of forty odd lectures the author presents a comprehensive view of the whole field of plant physiology. In the preface he states that it is his purpose to supply, in this volume, a book for the student, which will fill the gap between Pfeffer's exhaustive treatise and the short accounts found in various general text-books. In this he has succeeded and has filled a long-felt want for the reader who wishes a full, but not too detailed, account of the important facts and problems of plant physiology. There is a departure from the usual mode of treatment, in that the subject is divided under three main heads, instead of two. The first of these concerns the chemistry and nutrition of the plant and occupies somewhat less than half of the book. The rest is about equally divided between a section entitled 'Formwechsel,' treating of growth and reproduction, and another entitled 'Energiewechsel,' which has to do with movements of both growth and locomotion.

In general the treatment of nutrition does not differ materially from that of many other books, except that it is fuller. Under the general term assimilation is considered both photo-synthesis and the assimilation of nitrogenous substances. This is to be regretted, for it fails to bring out the essential differences between these forms of chemical activity within the plant. This is especially true since the author follows the fate of the nitrogenous products up to the point of the final construction of albuminous material and even considers the processes of digestion before a word has been said about respiration and the accompanying phenomena. It is true that in the following section, on dissimilation, as the author terms it, the phenomena connected with respiration are spoken of from the standpoint of the release of kinetic energy, but the importance of this in the upbuilding processes in nitrogen assimilation is not sharply brought out. The first part, on nutrition, closes with a cleverly constructed diagram which brings out the origin and fate of the various substances connected with nutrition processes.

In the already noted division of the balance of the book into two parts, it is not altogether evident that there is much advantage over the more usual plan. The problems connected with the change in form, in short the growth of the plant, are in many ways intimately connected with growth curvatures, yet in the arrangement followed the former are included under 'Formwechsel,' the latter under 'Energiewechsel.' If this treatment tends to draw the attention of the student from the relation of expenditure of energy to ordinary growth phenomena, or if thereby growth curvatures—tropism—are separated too sharply from unmodified growth responses, it seems to hinder rather than help the proper appreciation of the question as a whole. Some subdivision is certainly an advantage, but it might have been better if the title 'Energiewechsel' had been used for both of the sections and suitable subtitles devised to indicate more adequately the different phenomena.

Aside from such points, which are, perhaps, after all, but matters of opinion, there can be no question but that the book is an excellent one. It is clear, concise, fairly up to date as regards the literature, and, moreover, written in a style which makes it attractive and interesting reading. One can but regret that there is not a book in the English language so suitable for the student; it is to be hoped that a translation will appear.

Columbia University. H. M. Richards.

Cleiocrinus. By Frank Springer. Memoirs Mus. Comp. Zoology, Harvard College, Vol. XXV., No. 2, January, 1905.

A few years ago the Museum of Comparative Zoology brought out Mr. Springer's beautiful and exhaustive account of *Uintacrinus,* and now we have before us a similarly complete paper on one of the oldest of known Crinoid genera—*Cleiocrinus.* This genus was described by E. Billings in 1856, from specimens found in the Lower Silurian at Ottawa, Canada. It has been discussed by various authors, who have had great difficulty in placing it in the system of classification, owing partly to its anomalous character, and partly to the condition of the specimens. In 1886 Messrs. Wachsmuth and Springer wrote: 'If certain parts were better known, we should make it the type of a new family, but at present, having no positive knowledge of the basal regions, nor even of the arms, we are not in a position to give a satisfactory definition of the group.' Mr. Springer does not now establish the family Cleiocrinidæ, in so many words, but it is evident that the expectations of 1886 have been more than realized. The story of the discovery of the new characters is so dramatic that it is worth quoting nearly in full:

It was apparent, however, that no further information was to be obtained, unless we could find some means of seeing what is underneath the column. My examination of the specimens gave no hope of being able to detach the column in either of them; but after a very careful study of specimen B [one of Billings's types borrowed from the Geological Survey of Canada], under a strong magnifier, I came to the conclusion that it might be possible to get at the inside of the base by removing a part of the plates above it. * * * * The small size of the specimen and the uncertainty as to how the fractures might run, rendered the operation a delicate and risky one to undertake with a type specimen; but I thought the benefit to be gained in case of success would warrant the risk. I accordingly laid the matter fully before Dr. Whiteaves, and requested his authority to undertake it. This he gave without hesitation, and in the most liberal manner, leaving me free to act with the specimen as if it were my own. * * * The work of removing the necessary plates and debris from above the base of the specimen was tedious and difficult, being performed entirely under a ten-power microscope, with tools specially fashioned out of needles and fine steel pens. It was completely successful, however, without any mishap, and disclosed a structure most extraordinary and anomalous, unlike any of the previous suppositions, and wholly at variance with that of any other known crinoid.

It is finally concluded that the genus is intermediate between the great groups of Flexibilia and Camerata; nearest, apparently, to the Reteocrinidæ. The memoir is illustrated by a beautiful plate of drawings by K. M. Chapman and E. Ricker, showing not only all aspects of *Cleiocrinus,* but also *Reteocrinus* and *Glyptocrinus* for comparison.

T. D. A. C.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Journal of Experimental Medicine* established by Dr. W. H. Welch, of the Johns Hopkins University, will hereafter be published under the auspices of the Rockefeller Institute for Medical Research, and will be edited by Drs. Simon Flexner and Eugene L. Opie. The scope of the *Journal* will suffer no alteration by reason of the change of management, and it is hoped that it may continue to cover, as heretofore, the field of experimental medicine. It is proposed to issue numbers of the *Journal* at bimonthly intervals, six numbers to constitute a volume, which will contain not less than six hundred pages.

The opening (January) number of volume 6 of the *Transactions of the American Mathematical Society* contains the following papers:

P. F. Smith: 'On the linear transformations of a quadratic form into itself.'

E. V. Huntington: 'A set of postulates for real algebra, comprising postulates for a one-dimensional continuum and for the theory of groups.'

W. A. Manning: 'On the primitive groups of class $3p$.'

L. E. Dickson: 'The minimum degree τ of resolvents for the p-section of the periods of hyperelliptic functions of four periods.'

G. A. Miller: 'Determination of all the groups of order 2^m which contain an odd number of cyclic subgroups of composite order.'

E. D. Roe: 'On the coefficients in the quotient of two alternants.'

E. J. Wilczynski: 'General theory of curves on ruled surfaces.'

O. Veblen: 'Theory of plane curves in non-metrical analysis situs.'

The Museums Journal of Great Britain for January contains the second part of an article on 'School-Children and Museums,' by Henry Coates and Alex. M. Rodger, and 'The School Nature-Study Union,' under which is given a list of the museums, zoological and botanical gardens, in and about London and the facilities they afford teachers and students. There are a description of the Liverpool Museum as now arranged and a large number of notes about museums. Like *Nature* the *Museums Journal* is particularly strong in its notes, which form a most important portion of any scientific journal.

SOCIETIES AND ACADEMIES.

THE NEBRASKA ACADEMY OF SCIENCES.

The fifteenth annual meeting of the Nebraska Academy of Sciences was held in the Hall of Mechanic Arts, State University, Lincoln, January 27–28, and included a business session, sessions for the reading of papers and a social session on the evening of the latter date.

The following papers were presented:

Professor H. B. Duncanson: President's Address: 'The Relation of the State to Scientific Investigation.'

Dr. H. H. Waite: 'The Duty of the State to the Public in the Prevention of Certain Diseases.'

Dean H. B. Ward: 'Some Observations on the Biological Conditions of Elevated Lakes' (with lantern).

Professor O. V. P. Stout: 'An Economical Design for Measuring Flumes.'

Dr. G. E. Condra: 'The Possible Development of Nebraska's Stone-quarrying Industries.'

Professor F. D. Heald: 'Preliminary Note on a Black Rot of Apples.'

Dr. R. H. Wolcott: 'A New Mite Affecting Greenhouse Plants.'

Professor B. E. Moore: 'A Color Study of Cobalt Solutions.'

Professor L. Bruner: 'Some New Nebraska Orthoptera.'

Professor G. E. Chatburn: 'The Quality of Nebraska Timber.'

Dean Chas. Fordyce: 'Additional Notes on the Cladocera of Nebraska.'

Professor F. D. Heald: 'A Convenient Incubator for Student Work.'

Professor W. A. Willard: 'The Zoology of the Bermudas' (with lantern).

Professor W. W. Hastings: 'A Preliminary Report on the Respiratory Function.'

Mr. F. D. Barker: 'Some New Avian Parasites' (with lantern).

Professor F. D. Heald: 'A Disease of the Cottonwood.'

Professor G. R. Chatburn: 'Thoughts on Highway Improvement.'

Dr. S. R. Towne: 'How Typhoid is Spread.'

Professor J. H. Powers: 'Causes of Color Variation in the Amblystoma.'

Dean C. E. Bessey: 'Observations on Planted Forests in Europe.'

Mr. G. A. Loveland: 'The Effect of the Rotation of the Earth on Wind Direction.'

Dean E. W. Davis: 'How the Wind Changes its Direction.'

Mr. A. E. Sheldon: 'Some Prehistoric Indian Fire-places in the Bad Lands' (with lantern).

Dr. R. H. Wolcott: 'Some Observations on the Fauna of Nebraska' (with lantern).

Mr. E. E. Blackman: 'New Types of Nebraska Flint Implements' (with lantern).

Dr. G. E. Condra: 'Delimitation of Nebraska's Coal-bearing Formations' (with lantern).

Aside from the routine business which was transacted, resolutions were offered and passed endorsing legislation for the protection of non-injurious large game and other animals and also approving of the setting aside of forest and game reserves under government control.

The following officers were elected for the ensuing year:

President—Dr. R. H. Wolcott, University of Nebraska, Lincoln.

Vice-President—Dr. S. R. Towne, Nebraska State Board of Health, Omaha.

Secretary—Professor F. D. Heald, University of Nebraska, Lincoln.

Treasurer—Mr. A. E. Sheldon, Lincoln.

Directors—Mr. William Cleburne, Omaha; Dr. James B. Hungate, Weeping Water; Professor G. R. Chatburn, University of Nebraska, Lincoln; Professor G. A. Loveland, University of Nebraska, Lincoln.

Robt. H. Wolcott,
Secretary.

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The fifty-seventh regular meeting of the section was held Friday evening, January 27, at the 'Tech Union,' Massachusetts Institute of Technology, with President Norris in the chair. About sixty members were present.

Professor Frank H. Thorp, of the Massachusetts Institute of Technology, gave a paper entitled 'Some Notes upon Recent Foreign Literature of Chemical Technology.'

Mr. Arthur D. Little gave an eulogistic address on the 'Life and Work of the late Dr. Carl Otto Weber.'

Arthur M. Comey,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 163d meeting of the society was held on Wednesday evening, February 8, 1905. Messrs. David White, M. L. Fuller and W. T. Schaller presented informal communications, and the regular program was as follows:

Notes on the Fossils of the Bahamas: Mr. W. H. Dall.

The rocks of the Bahamas, apparently all Pleistocene, are of two kinds, marine sedimentary and æolian calcareous sands. The former contain the common marine West Indian shells now living about the Bahamas, with no extinct species. The æolian rocks proved to contain quite a fauna of land shells, especially characterized (like the recent land fauna) by the profusion of *Cepolis* and *Cerion*. In this respect it recalls the Oligocene land shell fauna of the Tampa silex beds, of which the Bahama Pleistocene shells are an analogue but not a derivative. The latter unexpectedly proved to contain a number of extinct species, doubtless the ancestors of the present fauna. Curiously enough, these ancestral forms are more like existing species of Haiti and Cuba than they are to their actual descendants, which may be accounted for on the hypothesis that a great increase in variability accompanied their invasion of the newly elevated land where there were no competitors, while the Haitian and Cuban forms from which they sprang have been kept true to type by the competition of the rest of the fauna by which they are surrounded. If there were any way of determining approximately the time which has elapsed since the elevation of the Bahamas above the sea in the Pleistocene epoch, we should have a means of determining the rate at which evolution and specific differentiation may proceed in such an assemblage of pulmonate mollusks placed in a suitable environment and not subjected to serious competition.

Pre-Cambrian Rocks of the Franklin Furnace Quadrangle: Mr. A. C. Spencer.

The view held by Rodgers, Cooke and Britton that the gneisses of the New Jersey Highlands are mainly metamorphosed sediments, has not been seriously challenged up to the present time, though two of the more recent investigators of the field (Nason in 1890 and Wolff in 1896) have left the way open for accepting an igneous origin for these banded feldspathic rocks. Field work in the vicinity of Franklin Furnace carried on during the summer of 1904 warrants the conclusion that, so far as this particular field is concerned, the only sediments are the white limestone and a few patches of quartzite, the several types of gneiss being undoubtedly igneous and in large part demonstrably intrusive. For the purpose of the geologic map five divisions of the pre-Cambrian rocks will be recognized: (1) the Franklin white limestone; (2) a complex of diorites and granites showing more or less gneissic structure; (3) black hornblende or pyroxene gneiss; (4) white granite gneiss, and (5) coarse granite or pegmatite.

Age relations have been established as follows: The pegmatites cut all the other rocks; the white gneiss cuts (2) and (3); the black gneiss cuts (1) and both phases of (2); and finally the granite phase of (2) cuts the limestone (1). The relation of the diorite phase of (2) to the limestone has not been observed.

Consanguinity in the Eruptive Rocks of Cripple Creek: Mr. L. C. Graton.

Mr. Graton showed that three magmatic groups may be distinguished, of which the most important is the series of rocks from the Cripple Creek volcano. All the rocks of this group possess certain characteristics in common and are of particular interest in having a constant ratio of silica to alumina—a proof of their derivation from a single magma. By making certain assumptions based on the field observations, the relative volumes of these rocks were computed, and by that means an analysis was obtained which was considered to approximate the composition of the total product from the magma reservoir, *i. e.*, the average rock of the Cripple Creek volcano.

The Big Sink on the Lucin Route across Great Salt Lake: Mr. J. M. Boutwell.

Mr. Boutwell described the construction of the long trestle extending across Great Salt Lake, and presented observations which have an important bearing on the question of the character and depth of the intermontane rock basins beneath the Pleistocene sediments. The author will later communicate a more complete statement to Science.

Geo. Otis Smith,
Secretary.

THE SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

The Science Club of Northwestern University held its regular monthly meeting in the physical lecture room of Science Hall, on Friday evening, February 3, 1905, at 7:30 p.m. Papers were presented by J. W. Goldwait on 'Post-glacial Land Movements in New England,' and by Professor U. S. Grant on 'Recent Contributions to Metamorphism.'

Floyd Field,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A NEMATODE DISEASE OF GRASSES.

In Europe there have been known for many years certain diseases of grasses, including wheat, caused by nematodes, which penetrate, in the larval state, the ovaries of the flowers and there reach maturity and lay their eggs. The resulting larvæ reach a certain degree of development and then, with the drying up of the host plant, coil up and dry out themselves. In this dried-out condition they may remain motionless but alive for years. On falling to the ground the affected seeds absorb moisture and the worms uncoil, bore their way out to freedom and, finding new grass plants, enter them and ascend to the flower, thus completing the circle of development.

The affected seeds are usually shorter, sometimes, however, much longer than the normal seeds and are incapable of germination. The glumes are much enlarged and the spikelets stand out at a different angle from, and are often more crowded on the axis. In fact, the affected plants may appear to be specifically distinct, and one case is known in America where a diseased plant was actually described as a new species, the presence of the nematodes having escaped the notice of the investigator.

Although known in Europe for a long time, practically no attention has been paid to this type of nematode disease in America. On behalf of the Bureau of Plant Industry of the U. S. Department of Agriculture, the writer has resumed his work, interrupted four years ago, on the nematode diseases of plants. He has found the disease in question in grasses from Texas, Oregon and Alaska, in the genera *Chætochloa, Agropyron, Elymus, Calamagrostis* and *Trisetum*. Two, possibly three, species of nematodes were found, all belonging to the genus *Tylenchus*. Cultural experiments are now under way to determine, if possible, whether any of them are identical with *T. tritici* of wheat in Europe. In the meantime, the writer would be very glad to receive all specimens of grasses and other plants suspected of harboring nematodes in their parts above ground as he wishes to determine what plants are affected and which species of nematodes cause the diseases.

Ernst A. Bessey.
U. S. Department of Agriculture.

SPECIAL ARTICLES.

THE OLYMPIC PENINSULA OF WASHINGTON.

A visit of five weeks in western Washington in 1902 gave opportunity for the following notes on a region as yet almost unexplored. The Olympic Peninsula forms the extreme northwest corner of the United States, and, as may be seen from any map, is almost cut off by water on every side. The climate is mild, temperatures ranging at sea level from 22° F. in winter to 86° F. in summer. The annual precipitation amounts to 120 inches at Neah Bay. Rain falls gently, and is to be expected for ten months of the year. In July and August there is usually no rain at all, so that the forest litter becomes very dry, and serious fires sometimes occur. Snow is only occasional at sea level, but at high elevations all of the precipitation is in the form of snow.

The peninsula is mostly occupied by the Olympic Mountains, an irregular group, radiating out from Mt. Olympus, 8,150 feet. Many other peaks rise from 7,000 to 8,000 feet, and large areas lie above 6,000 feet. As the whole tract is only sixty miles wide from east to west, and one hundred miles long, the hills and valleys are extremely rugged and precipitous. "Glaciers and snow-fields are numerous in the central parts of the mountains" (Dodwell and Rixon). Persons sometimes speak of the Olympics as volcanic, but we saw no sign of volcanism either in the rocks or in the pebbles of the Quiniault or Queets rivers. Along the coast a soft, green, marly, Cretaceous sandstone lies in gentle folds, each crest jutting out to sea as a steep headland 150 to 500 feet high. Rivers occupy the synclines. In the sandstone many fossils are found. Especially noticeable were stumps, logs and fragments of wood at different levels and in various stages of transition to lignite. Capping this stratum is a layer of recent yellow gravel, varying from ten to forty feet in thickness, and also enclosing logs and stumps. Below Point Granville the beach is low and sandy, but north of this steep cliffs rise directly from high water line. At various points (Copalis, Klaylock Creek) government inspectors have found indications of petroleum, but no other valuable minerals are known.

The vegetation of the Olympic Peninsula is truly remarkable. Below 5,000 feet is the great northwestern forest, which must be seen to be appreciated. Douglas fir, tideland spruce and 'red cedar' (*Thuja plicata*) reach gigantic proportions. The available timber per township runs from '3,000 feet B. M. amid the high mountains, up to 59,000 feet B. M. in the northwest corner' (Dodwell and Rixon). What with fallen timber and undergrowth of ferns and shrubs the forest is a veritable jungle. By hard work one can travel a quarter of a mile an hour off the trails!

Salal-berry (*Gaultheria shallon*) and species of *Rubus, Vaccinium* and *Ribes* contribute largely to the denseness of the jungle, and furnish abundant food for man and beast. The matted tree tops admit only a gloomy light below, and the darkness is deepened by great blankets of *Selaginella* (*S. oregana*) and bearded lichen (*Usnea*) depending from the branches. A thick bed of moss covers all the ground and swathes the bases of the tree trunks. Above 2,000 feet, however, the forest is quite open, but travel is impeded much more seriously by the impassably sharp hogbacks and steep canyon walls. The mountains slope more gently southward than on other sides, and it is believed that Mt. Olympus could be reached from the valley of the Quiniault River. The major part of the peninsula is held as the Olympic Forest Reserve. Two reports on this by Dodwell and Rixon (1, U. S. Geol. Surv., 21st Ann. Report, Part V., 1900; 2, ditto, Professional Paper No. 7, 1902) with maps and illustrations give the best accounts yet available concerning the region.

The fauna is equal to the flora in richness. Black bears, panthers, wild cats and wolves are numerous. A few squirrels and the mountain beaver are found. Deer and elk are plentiful. The garter snake is the only reptile. Wild duck and pheasants are occasional, and the familiar robin is seen about the houses. Salmon and trout of several kinds abound in all streams that are large enough. Quiniault salmon is said to be the finest on the coast. The report of the expedition from the Field Columbian Museum on the mammals of the Olympic Peninsula is the only record of its fauna.

In each river valley a distinct tribe of Indians originally made its home. The Makah at Cape Flattery were studied by Swan, and are an extremely interesting group. The Quillayutes and Quiniaults would equally repay an immediate investigation; but their old habits are rapidly vanishing before the government schools. Whites began to settle the Quiniault Valley in 1892, but the movement is very slow on account of the difficulty of clearing land and of getting produce in and out. It is estimated to cost $200 an acre to remove the timber enough for farming operations.

Here, then, is almost virgin soil for any kind of scientific investigation. Just enough has been done to enable the student to start intelligently and progress without interruption on any phase of this interesting region.

HENRY S. CONARD.

JOHNS HOPKINS UNIVERSITY,
February, 1905.

QUOTATIONS.

DR. OSLER ON THE PERIODS OF A TEACHER'S LIFE.*

I AM going to be very bold and touch on another question of some delicacy, but of infinite importance in university life, one that has not been settled in this country. I refer to a fixed period for the teacher, either of time of service or of age. Except in some proprietary schools, I do not know of any institutions in which there is a time limit of, say 20 years' service, as in some of the London hospitals, or in which a man is engaged for a term of years. Usually the appointment is *aut vitam aut culpam*, as the old phrase reads. It is a very serious matter in our young universities to have all of the professors growing old at the same time. In some places only an epidemic, a time limit, or an age limit, can save the situation.

I have two fixed ideas well known to my friends, harmless obsessions with which I sometimes bore them, but which have a direct bearing on this important problem. The first is the comparative uselessness of men above

* From his valedictory address at the Johns Hopkins University, given at the annual commemoration exercises on February 22, and printed in the *Journal of the American Medical Association*.

40 years of age. This may seem shocking, and yet read aright the world's history bears out the statement. Take the sum of human achievement in action, in science, in art, in literature—subtract the work of the men above 40, and, while we should miss great treasures, even priceless treasures, we should practically be where we are to-day. It is difficult to name a great and far-reaching conquest of the mind which has not been given to the world by a man on whose back the sun was still shining. The effective, moving, vitalizing work of the world is done between the ages of 25 and 40 years—these 15 golden years of plenty, the anabolic or constructive period, in which there is always a balance in the mental bank and the credit is still good.

In the science and art of medicine there has not been an advance of the first rank which has not been initiated by young or comparatively young men. Vesalius, Harvey, Hunter, Bichat, Laennec, Virchow, Lister, Koch—the green years were yet on their heads when their epoch-making studies were made. To modify an old saying, a man is sane morally at 30, rich mentally at 40, wise spiritually at 50—or never. The young men should be encouraged and afforded every possible chance to show what is in them. If there is one thing more than another upon which the professors of the university are to be congratulated, it is this very sympathy and fellowship with their junior associates, upon whom really in many departments, in mine certainly, has fallen the brunt of the work. And herein lies the chief value of the teacher who has passed his climacteric and is no longer a productive factor; he can play the man midwife, as Socrates did to Theaetetus, and determine whether the thoughts which the young men are bringing to the light are false idols or true and noble births.

My second fixed idea is the uselessness of men above 60 years of age, and the incalculable benefit it would be in commercial, political and in professional life if, as a matter of course, men stopped work at this age. Donne tells us in his 'Biathanatos' that by the laws of certain wise states sexagenarii were precipitated from a bridge, and in Rome men of that age were not admitted to the suffrage, and were called *depontani* because the way to the senate was *per pontem* and they from age were not permitted to come hither. In that charming novel, the 'Fixed Period,' Anthony Trollope discusses the practical advantages in modern life of a return to this ancient usage, and the plot hinges on the admirable scheme of a college into which at 60 men retired for a year of contemplation before a peaceful departure by chloroform. That incalculable benefits might follow such a scheme is apparent to any one who, like myself, is nearing the limit, and who has made a careful study of the calamities which may befall men during the seventh and eighth decades!

Still more when he contemplates the many evils which they perpetuate unconsciously and with impunity! As it can be maintained that all the great advances have come from men under 40, so the history of the world shows that a very large proportion of the evils may be traced to the sexagenarians—nearly all the great mistakes politically and socially, all of the worst poems, most of the bad pictures, a majority of the bad novels, and not a few of the bad sermons and speeches. It is not to be denied that occasionally there is a sexagenarian whose mind, as Cicero remarks, stands out of reach of the body's decay. Such a one has learned the secret of Hermippus, that ancient Roman, who, feeling that the silver cord was loosening, cut himself clear from all companions of his own age, and betook himself to the company of young men, mingling with their games and studies, and so lived to the age of 153, *puerorum halitu refocillatus et educatus*. And there is truth in the story, since it is only those who live with the young who maintain a fresh outlook on the new problems of the world.

The teacher's life should have three periods—study until 25, investigation until 40, profession until 60, at which age I would have him retired on a double allowance. Whether Anthony Trollope's suggestion of a college and chloroform should be carried out or not, I have become a little dubious, as my own time is getting so short.

REPORT OF THE COAST AND GEODETIC SURVEY FOR 1904.

THE report of the Coast and Geodetic Survey for 1904 is a record of manifold labors and results which have for their theater of action an area practically coterminous with that of the United States and all its island possessions. The main body of the report contains a detailed account of the wide range of important duties devolving upon this bureau, and in the appendices we have a presentation of discussions and results which must prove of great economical value and interest to surveyors, engineers, navigators and physicists.

The resurveys and developments imperatively required to show the changes in harbors and approaches, due to works of improvement or the ceaseless action of natural causes along the Atlantic, Pacific and Gulf coasts of the United States, and to meet the ever-increasing demands of our commerce and navy for up-to-date charts, particularly of the waters of Alaska, Porto Rico, Hawaii and the Philippines, gave constant employment to the eleven vessels available for these duties. The hydrography was prosecuted within the limits of the waters of sixteen states and territories and the topography was carried on in nine.

In Alaska the work included the continuation of the survey of Prince William Sound, the survey of Controller Bay and a deep-sea examination from the Strait of Juan de Fuca to Prince William Sound, preliminary to the laying of a deep-sea cable from Seattle to Valdez. The Porto Rico work was continued in certain bays and harbors as well as in the development of the conditions in the off-shore waters. In the Philippine Archipelago the survey has secured the cooperation of the insular government and a detailed résumé shows a most satisfactory progress of the triangulation, hydrographic, topographic, magnetic and astronomical operations. By utilizing native assistance in the Manila sub-office twenty-one charts were prepared for publication during the year, and the outcome of the experience with Filipinos as draftsmen, computers and engravers is the gratifying demonstration that they will prove equally as competent as the Hindoos have been found in the British Indian operations and the Malagassys have proved themselves in the French surveying work in Madagascar.

The reconnaissance for the primary triangulation along the 98th meridian was completed to the Canadian border and a scheme was extended eastward connecting this work with the triangulation of the Mississippi River Commission. The execution of the primary triangulation in the Dakotas and Texas was prosecuted at a rate which surpassed even the notable record which had already secured an enviable reputation for the geodetic operations along the 98th meridian, the total extension amounting to 300 miles (500 kilometers). An equal distinction must be accredited to similar work in California and Oregon whereon remarkable progress has been made in connecting the transcontinental arc work with Puget Sound.

The progress of the magnetic work is shown in detail in Appendix No. 3, which includes a table of results of the magnetic declinations, dip and intensity of force observed on land and sea during the year, this being supplemented with full descriptions of the magnetic stations occupied and meridian lines observed. A new feature is the inclusion of the observations of the three magnetic elements at sea by the Coast and Geodetic Survey vessels in the course of their regular surveying operations. The paper is replete with matters of interest to the surveyor, the mariner, the geographer and the geologist. Thus comprehensive examination has been made of certain locally disturbed areas, as for example, in Douglas Island, Alaska, in the region of the local magnetic pole found in 1900; and the completion of the magnetic survey of Louisiana in cooperation with the state geological survey revealed interesting and important results as regards both the magnetic distribution and the secular variation.

The table contains the magnetic results at 384 land stations distributed over 24 states and territories and 2 foreign countries. The table of sea results contains 52 entries of magnetic declination, 34 dips and 32 values of the total intensity of the magnetic force in the Atlantic and in the Pacific Oceans. The methods and instruments adopted for the sea work, which have thus far proved successful, are described in detail. In a general retrospective consideration of the work of the past five years it is pointed out that in this period observations have been made at 1,636 stations of which about one eighth are points previously occupied by the survey and since used for observations to secure data for ascertaining the secular change of the magnetic elements. The work in about a dozen states has been practically completed except for special investigations and secular change observations. During the year a bureau of international research in terrestrial magnetism has been created by the Carnegie Institution of Washington, with the inspector of the magnetic work of the coast survey in charge as director, and the cooperation thus ensured is certain to prove extremely profitable in results.

The determination of the longitude of Manila from San Francisco, thus completing the first longitude circuit of the earth, was one of the astronomical events of the year, and in Appendix No. 4 is a comprehensive illustrated report on the various instruments and operations used in the undertaking with a comparative résumé of the various links and results from which the longitude of Manila had been determined from the westward. The generous cooperation of the Commercial Cable Company, through whose patriotic enterprise the work was made feasible, is gratefully acknowledged. The results of the determinations from the eastward and westward differ only by $0^{s}.006$ or about 8.8 feet. The other results of this expedition are the determinations by the telegraphic method of the longitudes of Honolulu, and Midway and Guam Islands.

The third attempt at representing the tide for the world at large, the first having been made by Whewell and Airy and the second by Berghaus, is described in Appendix No. 5. The advancement in recent years of the general use of the harmonic analysis and the greatly improved tidal data that are now obtainable for such a great part of the globe coordinate to make a new presentation of this subject very opportune. The theoretical discussion of the problems involved, the wide range of data and authorities consulted and referred to, the graphic presentation of the cotidal lines, the results presented and the conclusions deduced make a most suggestive paper and one which will be highly interesting to all students of the subject.

The results of the precise leveling operations for the year are published in Appendices Nos. 6 and 7, which submit them in a detail that makes them immediately available for the requirements of surveyors and engineers. These extend the precise level net, as previously published, six hundred miles to the westward, from Red Desert, Wyoming, to Owyhee in eastern Idaho; and from Holland, Texas, two hundred miles southwest, to Seguin, Texas. An interesting feature is an account of the change in the manner of support for the leveling rods, with the comparative discussion of the old and the new methods and the consequent confirmation of the importance of the new system.

The account of operations submitted by the assistant in charge gives the story of the work of the various computing, drawing, engraving and chart divisions of the office, in which the results of the field work are discussed or prepared for the publications and charts wherein they are placed at the service of the public.

A full account of the first recording transit micrometer devised for use in the telegraphic longitude determinations of the Coast and Geodetic Survey is submitted in Appendix No. 8, with an account of the exhaustive tests it was subjected to and a recapitulation of the results of experience with this form of instrument, mainly in Europe, during the last thirteen years. The results of these experiments indicate that with the transit micrometer the accuracy of telegraphic longitudes may be considerably increased, if desirable, or the present standard of accuracy may be maintained at much less cost than formerly.

The results of all triangulation in California south of the latitude of Monterey Bay are printed in the concluding appendix in full, including descriptions of stations, as well as their latitudes and longitudes and the lengths and azimuths of the lines joining them. In compact and convenient form there is given all the information in regard to this triangulation that is needed by an engineer or surveyor who wishes to utilize the results in controlling and checking surveys or in constructing maps or charts. The locations of more than 1,300 points are accurately fixed by this triangulation.

The report, in addition to the details of the foregoing operations and results, contains a record of a wide range of important work for which the aid of a survey was sought because of the special training of its officers. The superintendent attended the Fourteenth General Conference of the International Geodetic Association as delegate for the United States and maintained direction of the observatories at Gaithersburg, Maryland, and Ukiah, California, supported by the International Geodetic Association for the purpose of measuring the variations of latitude; he was also detailed for duty in connection with the presentation of the case of the United States before the Alaska Boundary Tribunal being assisted by one of the officers of the survey. As commissioner of the United States he continued the work of remarking the boundary line between the United States and Canada from the Rocky Mountains westward, two of the officers of the survey being employed in the field; and as commissioner of the United States in the International Delimitation Commission he inaugurated the work of marking the boundary between Alaska and Canada, one of the parties being under the direction of an assistant of the survey. One officer continued on duty as a member of the Mississippi River Commission. One officer having completed the field work of the survey of Mason and Dixon's line, the boundary between Maryland and Pennsylvania, was then detailed to prepare the maps and report showing the results of the work. Another officer, at the application of the municipal authorities, remained in charge of the triangulation of the Greater New York territory, and one representative of the survey in cooperation with the Louisiana Oyster Commission continued the survey of the natural oyster beds and reefs for the state of Louisiana.

THE PRESERVATION OF AMERICAN ANTIQUITIES.

AT a joint meeting of the committees on preservation of American antiquities of the Archeological Institute of America and the American Anthropological Association, held at the Cosmos Club in Washington, on the evening of January 10, the subject of pending legislation was considered. It was decided that a memorandum should be prepared embodying such provisions from pending measures, as in the judgment of the joint committee should be incorporated into law, and the same presented to the House of Representatives' Committee on Public Lands, with the request that a bill should be prepared by this committee based on these suggestions.

Present: For the Archeological Institute of America, Dr. Seymour, Chairman, Dr. Putnam, Mr. Holmes, Mr. Bowditch, Dr. Kelsey, Dr. Carroll; for the Anthropological Association, Mr. Holmes, Chairman, Dr. Putnam, Miss Fletcher, Professor Saville, Dr. Gordon, Mr. Culin, Dr. Kroeber, Mr. Hewett.

The memorandum was submitted by the committee at the hearing before the Public Lands Committee on Wednesday, the eleventh.

At the meeting of this committee held on the sixteenth instant it was ordered to strike out all except the enacting clause of S. 5603 (the act known as the Lodge-Rodenburg bill which passed the senate last April) and insert instead "an amendment in the form of a substitute"; said substitute being, with a few minor amendments, the memorandum prepared by the joint committe above referred to. The bill as reported back, referred to the House Calendar, and ordered printed, is as follows:

SEC. 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled: That for the purpose of preserving and protecting from despoliation the historic and prehistoric ruins, monuments, archeological objects and other antiquities, on the public lands of the United States, all said historic and prehistoric ruins, monuments and other objects of antiquity are hereby placed under the care and custody of the Secretary of the Interior.

SEC. 2. That the Secretary of the Interior may make temporary withdrawals of the land on which such historic and prehistoric ruins, monuments, archeological objects and other antiquities are located, including only the land necessary for the preservation of such ruins and antiquities, and may make permanent withdrawals of tracts of land on which are ruins and antiquities of especial importance, not exceeding six hundred and forty acres in any one place.

Sec. 3. That the Secretary of the Interior be, and is hereby authorized to permit examinations, excavations and the gathering of objects of interest within such reservations by any institution either domestic or foreign which he may deem properly qualified to conduct such examinations, excavations or gatherings, subject to such rules and regulations as he may prescribe: *Provided*, That the examinations, excavations and gatherings are undertaken for the benefit of some reputable museum, university, college or other recognized scientific or educational institution with a view to increasing the knowledge of such objects, and that the gatherings shall be made for permanent preservation and not for commercial purposes.

Sec. 4. That of all excavations and explorations made under a permit granted by the Secretary of the Interior, a proper written and photographic record with plans shall be made at stated periods, and transmitted for preservation to the United States National Museum.

Sec. 5. That the Secretary of the Interior shall make and publish from time to time such rules and regulations as he shall deem expedient and necessary for the purpose of carrying out the provisions of this act.

Sec. 6. That all persons who shall without permission appropriate, injure or destroy any public property therein, or injure or destroy any caves, ruins, or other works or objects of antiquity therein, or commit unauthorized injury or waste, in any form whatsoever, upon the lands or objects referred to in this act, or who shall violate any of the rules or regulations prescribed hereunder, shall, upon conviction, be fined in a sum not more than five thousand dollars, or be imprisoned for a period not more than twelve months, or shall suffer both fine and imprisonment, in the discretion of the court.

Edgar L. Hewett,
Secretary.

SCIENTIFIC NOTES AND NEWS.

At the recent commemoration ceremonies at the University of Pennsylvania, the degree of Doctor of Science was conferred on Dr. R. S. Woodward, president of the Carnegie Institution. The colleagues of Dr. Woodward at Columbia University will join in giving a dinner in his honor on the evening of April 4.

Dr. William Osler gave a farewell address at the commemoration exercises at Johns Hopkins University on February 22. The degree of Doctor of Laws was conferred on him by the university.

Dr. Hans Landolt, professor of chemistry at Berlin, has been awarded the gold medal for science of the Berlin Academy of Sciences.

Dr. Paul Ehrlich, director of the Institute for Experimental Therapeutics at Frankfort, has been appointed honorary professor in the University of Göttingen.

Dr. Carl Moebius, professor of zoology at Berlin, celebrated his eightieth birthday on February 7.

Dr. Heinrich Limpricht, professor of chemistry at Greifswald, has celebrated his jubilee as university professor.

Professor Harry C. Jones, of the Johns Hopkins University, has been awarded $1,000 by the Carnegie Institution, with which to continue his work, on the nature of concentrated solutions, during the year 1905–1906. This is a renewal of the grant that he now holds for the same amount and for the same investigation. Dr. H. P. Bassett, who received his Ph.D. under Professor Jones in June, 1904, has been reappointed as his assistant.

The Committee on Science and the Arts, of the Franklin Institute, Philadelphia, has recommended to the Board of City Trusts that Dr. Persifor Frazer be awarded the John Scott legacy premium and medal for his 'system of quantitative colorimetry,' for determining the genuineness of exhibits of handwriting.

Mr. Henry M. Towne, president of the Yale and Towne Manufacturing Company, Stamford, Connecticut, and past-president of the American Society of Mechanical Engineers, gave on February 24, an address before the faculty and students of Purdue University. His subject was 'Industrial Engineering.' The university has also announced lectures at an early date by Mr. William Barclay Parsons and Mr. Frederic A. C. Perrine.

To perpetuate the memory of C. L. Herrick in the scientific world and among the friends of Denison University, and as a tribute of gratitude for his services, the Denison Scientific Association has appointed a committee to secure a fund to be known as 'The C. L. Herrick Memorial Fund.' The first purpose of the committee is to secure for Denison University Dr. Herrick's scientific library, which his family is obliged to dispose of. It is hoped, however, that only a portion of the fund will be used in procuring the library and that an adequate principal may be set aside, the income of which will be available in maintaining the serials represented in the library and in otherwise fostering the interests of science. A friend of the institution has promised to duplicate all subscriptions made for this purpose before July first next. Subscriptions may be sent to Professor Frank Carney, Denison, Ohio.

We regret to record the death of M. S. J. P. Folie, honorary director of the Observatory of Brussels, on January 29, at the age of seventy-one years; of Dr. Eduard Richter, professor of geography at Graz; and of Professor T. Bertelli, the Italian astronomer.

The U. S. Civil Service Commission announces an examination on March 29 to secure eligibles from which to fill a vacancy in the position of cement expert at $2,400, and another at $1,500 per annum, in the Reclamation Service, Geological Survey, and vacancies as they may occur in any branch of the service requiring similar qualifications. It is expected that in the near future there will be additional vacancies at salaries between $1,500 and $2,400 per annum.

The sixteenth session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences will be held at Cold Spring Harbor, Long Island, beginning July 5, 1905, lasting for six weeks. The usual courses of field zoology by Drs. Davenport and Breed, comparative anatomy by Drs. Pratt and Casteel, embryology by Drs. Crampton and Moenkhaus, cryptogamic botany by Dr. Johnson and Mr. Chivers, plant ecology by Mr. Shreve and Miss Knox and microscopic methods by Mrs. Davenport are offered. Those receiving instruction pay a fee of $30, but independent investigators may be received at the laboratory at any time upon application to the director, Dr. C. B. Davenport, Cold Spring Harbor, N. Y., from whom the announcement just issued may be obtained.

The legislature of North Dakota has passed a comprehensive irrigation code which follows closely the provisions of the suggested state irrigation code drawn up last summer by Mr. Morris Bien of the U. S. Reclamation Service. This is the first effective legislation on the subject in North Dakota, and will put irrigation investigation upon a well established and permanent basis, so that it is now possible to secure the exclusive services of a competent man as a state engineer. The first state engineer, Professor E. F. Chandler, who began that work last season and has been carrying it on in addition to his work as resident hydrographer for the U. S. Geological Survey and to his regular duties in the state university, now transfers the office to Mr. A. L. Fellows, of Denver, Colo., who has been for the past two years district engineer for Colorado of the U. S. Reclamation Service, and who now under the new law is appointed by Governor Sarles state engineer of North Dakota.

The trustees of the University of North Carolina have set aside the Shepard bequest of $5,000 as an endowment fund for the library of the chemical department of the university.

A reception was held in the Germanic Museum of Harvard University on February 28, at which Dr. Theodore Lewald, German imperial commissioner at St. Louis, presented to the university the collection of maps, charts and models on behalf of the German emperor for the sociological museum in Emerson Hall. Professor Münsterberg received the gift on behalf of the university.

In connection with the International Exposition to be held at Liège, Belgium, from April to November during the present year, it is proposed to hold an International Congress of Childhood from September 17 to 20 inclusive. The purpose of the congress is to consider the best means of promoting the physical, intellectual and moral development of youth in the home, the school and society. The congress will be organized in four sections, as follows: (1) Education of children; (2) study of children; (3) care and training of abnormal children; (4) parents' associations, mothers' clubs, and other supplementary agencies for the improvement of youth.

Senator Armstrong has introduced a bill in the New York legislature which provides for the establishment of a biological survey of the potable water of the state to prosecute a scientific study of aquatic organisms, their structure, their habits, food, distribution and variations. It is planned to consider such sanitary problems of a biological character as may arise in regard to the waters used by and available for the cities, villages and towns of the state. The sum of $5,000 is appropriated for the educational department of the state for apparatus and equipment and the sum of $10,000 for salaries of employees. If the bill becomes a law the work will be under the direction of Professor Clarke.

The complete collection of monographs possessed by the late Professor Gerhardt has been purchased and presented to the library of the Academy of Medicine by Dr. A. Jacobi.

The *Times* states that Sir H. A. Blake, governor of Ceylon, announced at a meeting of the Asiatic Society that Sinhalese medical books of the sixth century described 67 varieties of mosquitoes and 424 kinds of malarial fever caused by mosquitoes.

UNIVERSITY AND EDUCATIONAL NEWS.

The sad death of Mrs. Jane Lathrop Stanford will not greatly affect the administration or resources of the Leland Stanford Junior University. It will be remembered that for a long time her estate was tied up by litigation, but that in 1901 Mrs. Stanford made over to the trustees of the university practically all her property, including stocks conservatively appraised at $18,000,000 and real estate valued at least at $10,000,000.

It is announced that a new recitation building for Princeton University, to be known as McCosh Hall, will soon be erected behind the university chapel, at a cost of $100,000. The names of the givers are withheld.

Harvard University has received an anonymous gift of $5,000, the income of which is to be used for the assistance of meritorious students in the Medical School.

By the will of the widow of the late George P. A. Healy, the medical library collected by the late artist is bequeathed to Rush Medical College.

The University of Berlin has established an academic information bureau for the use of students, both native and foreign. It is prepared also to supply information on scientific subjects to visitors to Berlin.

Professor William James, of Harvard University, has accepted the acting professorship of philosophy at Stanford University. He will lecture at Stanford during the second half of the next academic year and will organize a department of philosophy for the university.

On account of illness, Professor C. R. Sanger, of Harvard University, is spending a few weeks in Cuba. During his absence, Professor Sanger's direction of the chemical laboratory is assumed by Professor T. W. Richards, in addition to the latter's regular duties as chairman of the chemical department. Dr. G. P. Baxter has temporarily taken full charge of chemistry 1, and has therefore been relieved of his course in gas analysis by Dr. R. C. Wells.

M. Henri Bergson has been appointed professor of modern philosophy in the Collège de France, in the room of the late Gabriel Tarde.

Dr. Otto Lummer, of the Reichsanstalt and docent at Berlin, has been appointed professor of physics at Breslau.

Dr. K. Kaiserling, docent and custodian of the pathological museum at Berlin since 1901, has been made professor.

Dr. Ludwig Claison, professor of chemistry at Kiel, has been called to Berlin.

Dr. Franz Hofmann, associate professor of physiology at Leipzig, has been called to a professorship at Innsbruck.

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FRIDAY, MARCH 17, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ALPHEUS SPRING PACKARD.

ALPHEUS SPRING PACKARD, for twenty-six years professor of zoology and geology in Brown University, died at Providence, February 14, 1905. He was born at Brunswick, Maine, February 19, 1831. His father, for whom he was named, was for over sixty years connected with the Bowdoin College faculty, and his grandfather, the Rev. Dr. Appleton, was one of the early presidents of the college.

At the age of eighteen he entered Bowdoin and there came under the influence and instruction of the late Paul Ansel Chadbourne, who fostered and encouraged his natural inclination towards zoological work. Dr. Chadbourne at this time was also connected with Williams College and it was through him that Packard became a member of the Williams College expedition of 1860 to Greenland and Labrador, with which he went only as far as Labrador, where he spent two months collecting, getting back to college in time for the studies of senior year. In the senior vacation he, with several other Bowdoin students, went on a dredging trip to the Bay of Fundy.

Immediately after graduation in 1861 he accepted the position of entomologist to the newly established scientific survey of Maine and in this capacity he traveled through a large part of the northern wilderness of the state. On this expedition he made the first discovery of Silurian fossils in the northern part of Maine and obtained material for several articles which were published in the first two reports of the survey.

He had now decided on his life work and after the season in the field, went to Cambridge to study with Agassiz. Here he devoted himself largely to the study of insects for the three years that he retained his connection with the Museum of Comparative Zoology, but in his spare time he read medicine and each winter he attended the lectures in the Maine Medical School connected with Bowdoin, from which he was graduated with the degree of doctor of medicine in 1864.

In the summer of that year he made a second trip to Labrador, where, with his enlarged experience, he was able to add greatly to the knowledge acquired on his former trip. As a result, besides several smaller papers, he published a large memoir on the geology and zoology of that region. Later this material was worked over and formed the basis of his book on 'The Labrador Coast.'

On his return from this second trip to Labrador he enlisted for three years as assistant surgeon and accompanied the first regiment of Maine Veteran Volunteers to Virginia, where he served until the end of the war. These ten months included the whole of his medical practise. After being mustered out he acted for a time as librarian and custodian of the Boston Society of Natural History, remaining there until 1866 when with several of his former fellow students—Hyatt, Morse, Putnam and Cooke—he accepted a position in the museum of the Essex Institute at Salem, at that time one of the most active scientific societies in the country.

Then came the founding of the Peabody Academy of Science in Salem. To it the Essex Institute transferred its collections and the scientific corps went with them, Packard being appointed curator of invertebrates and in 1876 director of the academy. Here he remained until 1878, when he accepted the position at Brown which he held for the rest of his life. While at Salem he held various other positions. He was for three years state entomologist of Massachusetts, lecturer for several years in entomology at the Amherst and Orono Agricultural Colleges, and for two or three years upon zoology and comparative anatomy at Bowdoin College. He also worked for two summers on the *Bache* and *Blue Light*, dredging for the U. S. Fish Commission in the Gulf of Maine. He was connected for a time with the Kentucky Geological Survey, when he made a zoological exploration of Mammoth Cave and laid the foundation of his later work on cave life. From 1875 to 1877 he was one of the zoologists of the U. S. Geological Survey under Hayden.

In 1873 Agassiz inaugurated the Anderson School of Natural History on the island of Penekese, the first summer school of biology in America. Here for two years Packard gave the instruction in insects and crustacea, and when with Agassiz's death the school was given up, Packard started a similar but smaller summer laboratory at Salem under the auspices of the Peabody Academy of Science which he conducted until his removal to Providence. This work was later taken up by the late Professor Hyatt at Annisquam, Mass., and continued until the establishment of the Marine Biological Laboratory at Woods Hole. In 1876 he was appointed by the President a member of the U. S. Entomological Commission which was to devise ways and means of checking the ravages of the Rocky Mountain locusts in the trans-Mississippi country. Later the scope of the commission, which lasted for five years, was enlarged so that it might deal with other insect pests. On this service he made two trips to the west, one taking him to the Pacific coast.

Besides these trips he spent the winter of 1869–70 in Florida, stopping on his return at Beaufort, N. C., from which place he brought back large collections of invertebrates. The next winter he spent at Charleston, S. C., where he studied the development of numerous marine invertebrates and especially of the crustacea, and where he collected the tertiary molluscs made known by F. S. Holmes. In 1872 he visited Europe, studying the collections of insects in the large museums and paying especial attention to Walker's types of lepidoptera in the British Museum. In 1885 he visited Mexico and in 1898 again spent a year in Europe and northern Africa.

Dr. Packard was a most indefatigable worker, the list of papers which came from his pen being numbered by hundreds. Only a few of these can be mentioned here. His first article was upon the army worm and was published by the Maine Scientific Survey. The years at Cambridge were chiefly spent in study, but some of the notes then made were incorporated in numerous later works, although large numbers of observations made in these early years remained unpublished at his death. His first large work was the monograph of the geometrid moths published by Hayden's Survey, and scarcely less imposing was his account of the Bombycidæ issued by the National Academy. His embryological work, which included studies on the development of the lower insects, appeared in the 'Memoirs' of the Peabody Academy of Science and in minor papers elsewhere, while his memoir on the development of the horseshoe crab remained for years the chief source of our knowledge of that interesting animal. This work was all done before the days of sections and was based entirely upon surface views and optical sections, a fact for which allowance should be made when his mistakes are recalled. His papers on the geology and natural history of Labrador and on the cave animals have already been alluded to. Possibly his best article was the 'Monograph of the Phyllopod Crustacea' published in the last report of Hayden's Survey.

Packard was possibly best known for his text-books. The earliest of these was his 'Guide to the Study of Insects,' which for years served as the *vade mecum* of hundreds of budding entomologists. Then came his 'Life Histories of Animals,' which was the first attempt since the day of Agassiz's Lowell Institute lectures to summarize the facts of embryology, a work which was early superseded by Balfour's admirable treatise. Then came his 'Zoology,' the first attempt to give American students a truly scientific text-book in which morphology and classification were given equal prominence. This was followed by several smaller and more elementary works for lower schools, some of which have had a large sale. Later came a second work on entomology, in which the morphological side of the subject was strongly emphasized.

Packard, along with his friends Cope and Hyatt, must be regarded as one of the founders and chief supporters of the so-called Neo-Lamarckian school of evolution, and his writings in advocacy of these views are numerous. His studies in this direction led him to study deeply the writings of Lamarck and later to bring together all the known facts in the life of this early apostle of evolution. In fact his second trip to Europe was largely for the purpose of ascertaining everything possible concerning the man.

In speaking of Dr. Packard one should not forget the services he rendered to science as one of the founders and for twenty years as editor of the *American Naturalist*. Almost as soon as he reached Salem the magazine was launched and while one by one the other editors dropped out Packard remained in charge. In these days of numerous natural history magazines one can hardly realize the boon the establishment of this journal was to the naturalists of the country, and few know its financial vicissitudes and the sacrifices of its editor during its early days.

Personally, Dr. Packard was one of the most companionable of men. He was always ready to aid and assist the young in their natural history studies to the extent of his powers. He was critical of the language in which they clothed their facts and the pages of the *Naturalist* have profited by his revision. He rarely indulged in controversy, and although he could say sharp and cutting things, one may look in vain in his published works for any traces of polemics.

Dr. Packard was married in 1867 to Elizabeth Derby, the daughter of the late Samuel B. Walcott, of Salem, who, with four children, one a rising naval architect, survives him.

J. S. Kingsley.

Tufts College, Mass.

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*ALPHEUS SPRING PACKARD.**

I have not known Professor Packard as long, nor as intimately, as many of my colleagues; and where they have spoken I should remain silent. Neither am I qualified to discuss his more immediate scientific work. I can, however, in response to the President's suggestions, speak of him in the light in which one scientific man sees another, older and wiser than himself; but I do so with diffidence. I have, therefore, written down with some care the things which I would not otherwise venture to express.

It seems an ungracious confession to make, but it is nevertheless true, that it was through Professor Packard that many of us in Washington, twenty or thirty years ago, became aware of the existence of scientific activity at Brown University. For age had wearied the enthusiasm of Alexis Caswell twenty years earlier. Yet it was not by his presence that Packard represented her; at least in the years in which I knew him, he was not a frequent attendant at scientific meetings remote from Providence. It was his untiring and remarkably pervasive industry that confronted us. The president of the National Academy, the director of the Geological Survey and others in authority all felt the force of it; and at one time there were dismal mutterings in the high places of legislation asking why the public printer's time should be spent in bringing out the elaborate researches of one who stood remote from public office. How did this come about? Certainly a man of Professor Packard's singular modesty, of his almost morbid habit of self-depreciation, was the last to find his way through the mazes of a government lobby. His transparent sincerity would have been infinitely removed from all this. And yet there was no mystery about it. It was a mere force from within breaking its way. The power of Professor Packard's intellect bearing on subjects of natural history, the scope and accuracy of his learning and the purity of his scientific ideals were his only resources; and wherever institutions needed the fruits of ripe scholarship to dignify their own scientific activities, these were the first to feel the influence of Professor Packard's productive zeal, as they were compelled to guide its progress. And so our unobtrusive colleague taxed the people of the whole United States to publish his magnificent memoirs—because he was genuine.

The same facts appear in a different way, in the further story of Professor Packard's life. I am the last man to speak lightly of the young vigor and the promise of our American institutions, or of our

* Address given at the memorial exercises at Brown University. Printed in Science at the request of the editor.

learned societies. But it is nevertheless true that in comparison with the famous academies of the old world we are as yet mere children. In a history of the *essentials* in the progress of science, there is but rare need of the mention of American accomplishments. We have much of the practise, and we show a degree of independence in our imitations; but we lack the philosophic depth, the intuitions and the profound originality. It is to the lawgiver of science that the true academy is born, and it is by her lawgivers again that it must be nurtured. To men of exquisite genius no climate within the whole range of our immense country has yet been congenial.

We are apt to smile at the Englishman for the letters which decorate his name. We laugh at the German for his titles and at the Frenchman for his ribbons and his uniform. We smile because to us such insignia mean nothing; and it is to our shame. We forget that these symbols voice a sentiment of almost religious purity. We have not yet learned to constitute nor even to revere a tribunal so august as to be incompatible with pettiness. We never ask why the F.R.S. is inseparable from the names of Lord Kelvin, of Lord Lister, even in their age and amid the splendors of their glory. To make the French Academy, even on its scientific side, required the brains of Cuvier, of Lamarck, of St. Hilaire, of Buffon, of the brothers Jussieu, of Pasteur; it required Laplace, Lavoisier and Lagrange, Carnot and Cauchy, Fresnel and Fourier, Ampère and Arago, Poisson and Poinsot, to mention only a few; and the dictum of the academy arbitrates with the authority of these tremendous names.

Precisely to such bodies of inexorable critics did the intrinsic strength of the work of Professor Packard ultimately appeal. And it was from the judgment of his confrères, from the men who had themselves traversed the same intellectual territory and knew it, that he reaped his supreme honors. From these alone could the reward have come; for below the decisions of his peers, there was no other guide but conscience.

Few of us realize how difficult it is, what persistent convictions, what sturdy vigilance is required to enter seriously into competition with the whole world, as Packard did; indeed one might say to enter handicapped, against a world richer in its traditions, more refined in its higher intellectual atmosphere, more bountiful in its opportunities, than our young country. It takes courage to press forward alone, self-reliant, misunderstood, at peace only with one's own convictions. Did we think of this in Packard's case? Did we look at his Linnean and other honors in this light? Did even our corporation feel that the *cause* of which it is the supreme guardian, had in Packard been awarded with the most cherished tokens of the world's approval?

Packard was not lacking in his reverence for art, for literature, for music; but his soul cried out for science. He felt instinctively that the handiwork of man, however sublime, can not be more than human; and that a finite brain has fashioned all its cultures. Nature is the offspring of omniscience. He realized what the world was so slow to realize, what only within the last few hundred years has come like a tumultuous awakening, that the universe was wrought in the workshops of God, and that she alone is ultimately divine. He felt too that her true poetry is not written in rhetoric but in mathematics and in the stern logic of science. For all our natural philosophies are but an attempt at a picture. We find no adequate symbols in our efforts to restate her methods; our analogies, our metaphors, are gross; we have to shift, to approximate, to neglect. But nature neglects nothing! To her the infinitely large and the infinitely small on the boundaries of which we live are alike finite among her infinities. Touch her at any point and your contact is with the eternal.

To contemplate the prolific labors of Professor Packard is to stand face to face with the attributes of genius. I do not wish to make an over-statement. True, there is an order of genius among the geniuses, but there is none in whose heart the sacred fire does not burn. There can be no holier joy than the joy of creative work, and yet it is a joy akin to terror. What is it which possesses a man even in early youth, which impels him despite all obstacles and restraint to strive evermore, intellectually alone, without approval, profitlessly after an unattainable ideal; whose spell grows more potent as his years ripen, as his toil increases, as the world grows caustic in its rebuke; and that leaves him only with death? Do not suppose that the poet or the sculptor or the martyr alone have it. It burns to-day with subdued passion but with all its pristine and unmitigated fierceness in the life of every true student of nature.

What is it that can sustain a man when every new avenue of thought discovered is but the approach to countless avenues beyond; when to finish, be it after years of labor, is only to be ready to begin; what encourages him when the unknown looms with greater vastness as the known is more profoundly mastered; when the very pinnacle of attainment is the sublime consciousness of ignorance, and when to be most renowned is to be most devoutly humble? It is the inspiration which illumined the life of our friend, our colleague, our teacher. Long may his ideals guide us at Brown!

Carl Barus.

Brown University.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

The sixth meeting of the society was held December 27–30, 1904, at Philadelphia, Pa., during convocation week, in affiliation with the American Association for the Advancement of Science.

Three sessions of the society for the reading and discussion of papers and the transaction of business were held in room 106, College Hall, University of Pennsylvania, on Wednesday, Thursday and Friday afternoons. The number of members present at some time during the meeting was thirty-six and the average attendance was about fifty.

A pleasant social feature connected with the meeting was an informal dinner at the Hotel Walton, Thursday evening, at which twenty-six members and friends were present. Through the courtesy of Director Doolittle, a number of the members had the pleasure of examining the equipment of the Flower Observatory of the University of Pennsylvania at Upper Darby, and by the courtesy of Professor Snyder the extensive astronomical equipment of the Philadelphia Observatory was inspected by a considerable party.

During the meeting five new members were elected. The selection of a time and place for the next meeting was left open for future action by the council.

The officers elected were:

For 1905:

President—Simon Newcomb.

First Vice-President—George E. Hale.

Second Vice-President—W. W. Campbell.

Treasurer—C. L. Doolittle.

For 1905–6:

Councilors—W. S. Eichelberger, Ormond Stone.

On account of the contemplated absence from the country of G. C. Comstock for the greater part of the year 1905, W. S. Eichelberger was elected by the council as acting secretary.

W. S. Eichelberger and C. L. Doolittle represented the society in the council of the American Association for the Advancement of Science.

By request of a committee of the National Academy of Sciences appointed to secure international cooperation in solar research, a committee from this society was appointed by the president during the preceding summer to cooperate with the committee of the National Academy. The council has made this a standing committee of the society.

PAPERS PRESENTED.

C. L. DOOLITTLE: 'The Constant of Aberration.'

JOHN F. HAYFORD: 'A Test of The Transit Micrometer.'

ERIC DOOLITTLE: 'Remeasurement of the Hough Double Stars.'

D. P. TODD: 'Novel Design for Rotating Dome Track.'

EDWARD S. KING: 'A Study of the Driving Worms of Photographic Telescopes.'

C. L. DOOLITTLE: 'The Reflex Zenith Tube.'

ANNIE J. CANNON: 'Variations of the Bright Hydrogen Lines in Stellar Spectra.'

HENRIETTA S. LEAVITT: 'Variable Stars in Large Nebulous Regions.'

PERCIVAL LOWELL: 'Planetary Spectrograms, the Work of V. M. Slipher and C. O. Lampland.'

PERCIVAL LOWELL: 'The Canals of Mars: An Investigation of Their Objectivity.'

FRANK H. BIGELOW: 'Note on Three Solar Periods.'

JOHN A. PARKHURST: 'The Coordination of Visual and Photographic Star Magnitudes.'

HEBER D. CURTIS: 'The Quadruple System of Alpha Geminorum.'

HAROLD JACOBY: 'Use of the Method of Least Squares to decide between Conflicting Hypotheses.'

HAROLD JACOBY: 'Tables for the Reduction of Astronomical Photographs.'

EDWARD C. PICKERING: 'Recent Researches of the Henry Draper Memorial.'

ORMOND STONE: 'Calibration of a Photographic Photometer Wedge.'

J. G. HAGEN: 'Note on Two Variable Star Catalogues.

'Useful Work for a Small Equatorial.' A proposed discussion. To be opened by Edward C. Pickering.

ABSTRACTS OF PAPERS.

The Constant of Aberration: C. L. DOOLITTLE.

The systematic observation for variation of latitude was begun by the author December 1, 1889. This work has been kept up with some interruptions since that time. In 1896 was begun at the Flower Observatory a series which it was proposed to continue on a uniform plan for a period of seven years. This design was carried out with but little departure from the original program. Observation on this series was terminated December, 1906.

Work is now in progress on a more comprehensive plan, two instruments being employed, viz., the 5½-inch zenith telescope and the 8-inch Wharton reflex zenith tube.

The close of the former series seems to mark the proper time for bringing together the values of aberration constant which have been obtained, and for combining them to form a mean which may be considered final so far as may be shown by these observations.

The different values found are as follows:

SAYRE OBSERVATORY, SOUTH BETHLEHEM.

Date.	Aberration.	No. Pairs.	Wt.
1889 Dec. 1—1890 Dec. 13	20".448±014	1479	0
1892 Oct. 10—1893 Dec. 27	20 .551±009	2900	1
1894 Jan. 19—1895 May 16	20 .537±014	1989	1
FLOWER OBSERVATORY, PHILADELPHIA.			
1896 Oct. 19—1898 Aug. 16	20".580±008	2009	1
1898 Oct. 8—1899 Nov. 27	20 .540±010	1503	2
1900 May 5—1901 Aug. 30	20 .561±008	1994	2
1901 Oct. 3—1902 Dec. 1	20 .513±009	1935	2
1903 Jan. 22—1903 Dec. 7	20 .524±009	1554	2

The reasons which have led to assigning the wt. 0 to the first determination will be found fully set forth in connection with the published results of this series.* For various reasons which are fully explained elsewhere the first series at the Flower Observatory is not thought to be as reliable

* *Transactions of the American Philosophical Society*, Vol. XX., p. 318.

as the following ones. It has accordingly been assigned the wt. 1, the four remaining values being given the wt. 2. Combining according to these weights, we find for the mean,

$$20''.540 \pm .0055$$

I wish this to be regarded as the definitive value of this constant as derived from the zenith telescope observations extending from December, 1889, to December, 1903.

The Test of a Transit Micrometer: John F. Hayford.

When, in connection with an astronomical transit as used for time observations, a transit micrometer and chronograph are substituted for a system of fixed lines in the diaphragm, a telegraphic key and a chronograph, the observer is relieved of the necessity of operating the key at, or as soon as possible after, each of the several instants of transit of the star across the fixed lines. Instead, he is required simply to keep the star image bisected continuously by the movable micrometer line during its progress across the field of view. In the new process of thought the element of time enters only in an indirect manner. Hence, with a transit micrometer the personal equation becomes so nearly zero, and its variation so nearly zero, that it is difficult to prove that they are not both absolutely zero. The personal equation is one of the most serious sources of error in all time determinations and determinations of right ascension. The destiny of the transit micrometer is to produce a decided increase in accuracy in this class of observations without increase of effort or cost.

The observation of star transits by means of a movable transit line was first suggested in 1865 by Director Carl Braun of the Kalocsa Observatory. He believed that it was necessary to have the movable line driven by clockwork. He failed to construct a satisfactory apparatus.

Repsold, the well-known instrument-maker, was the first to suggest in print, in 1889, that no clockwork is required. He constructed a hand-driven transit micrometer with which excellent results were secured.

The Prussian Geodetic Institute put the Repsold hand-driven transit micrometer into use on portable instruments in making telegraphic longitude determinations in 1891, and has continued its use to the present time. In all, it has been used in ten longitude determinations.

Utilizing the published past experience with transit micrometers Mr. E. G. Fischer, chief of the Instrument Division, Coast and Geodetic Survey, designed and constructed in the winter of 1903–4 the transit micrometer which is before you, and which is adapted for use on the transits ordinarily used in longitude determinations.

It is a hand-driven transit micrometer. It is so well designed and constructed that in the extensive tests, to which I will refer in a moment, it never required the slightest change in adjustment, not even of the pressure of the contact spring, and not a single record was ever lost on account of any failure of the transit micrometer to operate properly.

A peculiar and important feature of this transit micrometer is an automatic switch which operates, without the slightest attention from the observer, in such a manner that a record is made on the chronograph for the middle four turns of the field, and for those turns only. This positively identifies those four turns, keeps the chronograph sheet clear, and enables the observer to practise following the star during the earlier part of its transit without affecting the chronograph sheet in any way.

In March, April and May, 1904, this instrument was tested by 75 time sets on 18 nights at the Coast and Geodetic Survey office. Sixteen observers took part in this test. The observers were purposely selected so as to include some with little or no experience in any kind of observation, some with long experience in astronomic observations and in handling various instruments of precision, and some of various grades between these two extremes. Two observers worked at the same time, observing alternate stars, and thus obtaining a determination of their relative personal equation. One of the sixteen observers was in the test continuously, became thoroughly accustomed to the instrument and method of observation, and served as an intermediary through which all the other observers could be compared with each other.

The tests show that for a practised observer with such a transit micrometer, the total error for a star, including errors which are constant for all the records as well as the accidental errors of bisection, is nearly the same for stars of all declinations if expressed in angular measurement. This is what should be expected if the errors concerned are of the same nature as if the object pointed upon were stationary instead of moving.

The accidental errors of bisection are nearly the same expressed in angular measure for stars of all declinations up to 59°, and are probably somewhat less for stars of greater declination. This is an indication that the accidental errors of bisection are of the same nature as if the image pointed upon were stationary, the indication being partly contradicted by the smaller errors for stars of declination greater than 58°.

Good observations can be secured at once with the transit micrometer without previous practise. Practise simply reduces the accidental errors by about 25 per cent. I feel that I may speak with assurance on this topic, for each of the sixteen observers was forced to begin observing on the first star that appeared in his field of view, with no previous experience whatever. This point is emphasized for the reason that I had been led to expect that long practise would be necessary before an observer could be sent to the field with a transit micrometer. The accidental error of a single record with the transit micrometer is about the same as that of a single record with a key.

During the first half of the tests the driving heads were geared to make one turn in $2^{s}.4$, when observing an equatorial star. During the last half of the tests the driving heads were geared to turn one half as fast, namely, one turn in $4^{s}.8$. This extreme change in speed produced surprisingly little effect on the accuracy of the result. With this instrument the speed of $4^{s}.8$ per turn, or possibly a slightly slower speed, is believed to be most favorable to accuracy.

The tests show that the relative personal equation between any two observers with the transit micrometer is so small as to be masked by the accidental errors of observation. This is equivalent to saying that it is probably less in every case than $^{s}.05$, and is, as a rule, much smaller than this. The relative personal equation with a transit micrometer is certainly not more than one tenth as large, upon an average, as with a key. This conclusion as to the relative personal equation applies to inexperienced as well as experienced observers.

The literature of the transit micrometer shows abundant corroboration of these conclusions as to the relative personal equation.

It is difficult to detect constant or systematic errors of any kind in transit micrometer observations. All the errors seem to belong to the accidental class.

This is far from being true of key observations.

The transit micrometer is about to be put into use in the regular longitude work of the Coast and Geodetic Survey.

I predict, basing my prediction upon the general experience with transit micrometers as well as on these particular tests, that with a transit micrometer three nights of observations without an exchange of observers will give as great accuracy as has been secured in the past from ten nights of observations with a key, including an exchange of observers. This is a prediction of which the truth or falsity can only be proved conclusively by field experience. I rely upon such experience to be gained within the next five years to verify the prediction.

I venture to predict also that the evidence in favor of the transit micrometer will accumulate to such an extent in the next ten years in fixed observatories, as well as with portable instruments, that the astronomer who uses a key in 1914 for accurate time determinations or determinations of right ascension will have difficulty in furnishing adequate explanation of his conduct.

An illustrated description of the Coast and Geodetic Survey transit micrometer, with a full report of the tests referred to above, and a brief résumé of a part of the literatnre of the transit micrometer, is now being printed as an appendix to the Coast and Geodetic Survey Report for 1904.

Remeasurement of the Hough Double Stars: Eric Doolittle.

The catalogues of new double stars published by Professor Hough comprise 622 pairs, of which 77 are closer than $\frac{1}{2}''$ and 143 closer than $1''$; in those pairs in which the distance is greater than $5''$ the companion is usually excessively faint; in fact, there are few of the stars which would not be difficult with a telescope of much less than 18 inches aperture.

The measurement of this fine series of doubles seems to have been strangely neglected. On a few of them, which are of the type of close pairs of equal magnitude, as 98, 260 and 296, there are a number of rather discordant measures, but the great majority have received no attention except from the discoverer himself. Thus there are but 87 pairs which have been measured in two different years, and on no less than 358 there is but a single prior measure.

The entire list was, therefore, added to the observing list for the 18-inch refractor of the Flower Observatory. Thus far, 360 pairs have been measured on three or more nights and many of the remaining 262 are partially measured; a single night's measure consists in each case of at least four measures of position angle and four of the double distance.

Change has been found in 16 of the close pairs, and among the wider ones there is in 33 instances indication of proper motion.

It is the intention, when the work is completed, to publish a catalogue of these stars, including about twenty new pairs which Professor Hough has discovered since his last list was issued.

A Study of the Driving-worms of Several Photographic Telescopes: Edward S. King.

In following a star with a photographic telescope we must have for the period of the exposure a clock the hour hand of which will indicate the elapsed time on a scale graduated to seconds or less. We must have the equivalent of being able to determine the time by measuring the position of the hour hand with a micrometer. If any periodic error occurs in the train of the driving mechanism, causing the telescope to be first in advance of, and then behind, its proper position, the stellar images will be elongated into lines having a length dependent upon the amount of the oscillation. If the telescope follows the star only at one extremity of the oscillation, we shall have a series of images separated by trails, or, if the rate of the telescope is changed more, we shall have a trail with dark knots appearing at regular intervals. The number of the knots determines the frequency of the oscillation, and almost invariably indicates the driving-worm or endless screw as the offending member.

Such a periodic error, as shown by slide 1, is present in nearly all telescopes driven in this manner. This fact is not anything new, but has been recognized for years. The first example that I know of personally occurred in 1888 with the Boyden thirteen-inch telescope. In 1896 the director asked me to determine the periodic error of two of our photographic telescopes. Several series of measures were made of the eight-inch and the eleven-inch Draper telescopes. The method was to view a point of the tail-piece through a fixed microscope fitted with a micrometer. After each release of the detent by means of the signals given by hand, the position of the point was read and recorded. The reduction of these measures shows that the oscillation for the eight-inch Draper telescope was about 1 second, and for the eleven-inch Draper telescope about 0.2 second. These figures correspond to trails of less than 0.01 cm. on the plate. Within a few years Dr. Hartman has studied the periodic error of the Potsdam refractor and provided a very ingenious method of correction. A full account of his work will be found in the *Astronomische Nachrichten*, No. 3,769, page 2.

Nothing further was done here until the present year, when one of the small cameras was provided with a new mounting. The images proved to be lines lying in the direction of the clock's motion, and might, therefore, be affected by a periodic error. I proceeded to investigate the difficulty by a photographic method. The polar axis of the instrument was displaced in azimuth by a large amount. Such a displacement would cause equatorial stars, particularly when near the meridian, to move over the plate in declination. If an oscillation occurred, it would appear in the sinuous character of the trail. Slide 2, which is enlarged ten times from the original plate, shows the result, permitting no doubt as to the nature of the error. The numerous elongated objects are images of stars obtained on the same plate in the ordinary way. It is seen that the elongation of the images corresponds to the amplitude of the oscillation as exhibited by the vertical trail. The number of the oscillations was fifteen per hour, which fixes the responsibility upon the worm. A similar experiment made with a worm which had given satisfactory images is shown in slide 3. A slight irregularity is seen, but does not prove injurious. The same experiment made with the eleven-inch Draper telescope did not show anything definite, due probably to the smallness of the error. It is possible that it could be brought out by attaching an enlarging apparatus to the instrument and this will be tried soon.

The defective worm and several others were also tested visually. A telescope of about four feet focal length and having an eye-piece provided with a crosswire, was lashed to the camera and directed to a scale graduated to millimeters and placed at a distance. I was thus able to record the position of the telescope accurately. After every ten beats given by hand to the driving mechanism, the position was read for a period covering more than a revolution of the worm, which occurred in 240 seconds. The readings at the beginning and the end of the revolution determined the average rate from which were found the positions which the telescope should have occupied for the intermediate times. A comparison with the observed positions gave the periodic error. It was possible for the worm to be defective either in the thread itself or in the mounting. Rowland makes the remark that the correct mounting of a screw is more difficult than making the screw. It seemed to be so in the present case. If the screw was mounted eccentrically, we might expect a great improvement if it were allowed to engage only lightly with the R. A. wheel, being held in position by a strong spring. Slide 4 exhibits the resulting curves. It is seen that when the worm was adjusted to engage only lightly with the R. A. wheel, the oscillation extended through nearly eight seconds, but that, when brought into contact, the range was hardly two seconds. Thus the error of this particular worm was eccentricity.

A further test was made to determine if any intermediate adjustment of the worm with respect to the R. A. wheel would be advantageous. Slide 5 gives a set of curves for the various settings, beginning with the position in contact and ending with the worm very lightly engaged. Curve 1 is best and curve 3 is worst. That the position in contact is not always best is shown by slide 6, giving results for the worm that proved satisfactory. In this case the action was quite erratic when the worm was in contact.

A further test was made of the eleven-inch Draper telescope to determine the best adjustment of the worm with respect to the R. A. or sector wheel. Slide 1, which has already been seen, shows the appearance of the trails at what may be considered an average adjustment. In slide 8 we have the result when the worm is in contact, and in slide 9 when the position is adjusted to give the least error, found by trial. Probably in all instruments, one may, without any process of reconstruction, find by experiment where the periodic error is much decreased.

The foregoing has been in the nature of an abstract of an investigation in progress rather than a detailed account of work complete. It is possible that a careful study of curves representative of the action of the driving-worm will suggest an improvement in cutting the thread. As the experiments are easily made, I hope that other observers will test their instruments. A comparison of the results obtained with a greater variety of instruments would be of interest and might lead to a better understanding of the entire subject.

The Reflex Zenith Tube: C. L. Doolittle.

In 1851, or thereabout, the instrument having this designation was installed at Greenwich. The maker was Mr. Simons, the designer Mr. J. B. Airy. The immediate object in view was the observation of γ *Draconis*, a star which has been followed at Greenwich with some kind of zenith instrument since the time of Bradley.

The principle is briefly as follows: The telescope is fixed permanently, with its axis vertical as nearly as may be. Below the objective at a distance nearly half that of the focal length is placed a basin of mercury. The rays from a star at the zenith after passing through the objective, are reflected from the mercury surface and brought to a focus immediately in front of this objective. By means of a micrometer, the frame of which is firmly attached to the cell of the objective, with the plane of the reticule passing through the focus, the zenith distance of a star culminating within ten or fifteen minutes of the zenith may be measured. Finally a diagonal reflector brings the ray to the ocular, which is at right angles to the axis of the objective.

In practise the observation is made by bisecting the star, then quickly reversing by turning the objective with the micrometer attached through 180°, then making a second bisection. One half the difference of the micrometer readings will evidently be the measure of the star's zenith distance. Obviously both bisections can not be made with the star on the meridian. This makes necessary a small correction easily determined.

An instrument involving these principles has recently been installed at the Flower Observatory. So far as I am aware this is the second to be constructed. In detail, it differs in a number of particulars from the Greenwich instrument. The optical parts are by Brashear, and the instrumental parts by Warner and Swasey. The aperture of the objective is eight inches, the focal length one hundred inches. In the Greenwich instrument this cone of light after reflection passes a second time through the glass of the objective. In this case a hole one and one half inches in diameter is bored through the objective; through this hole a short tube passes, attached above to the micrometer box. When not in use this tube is closed by a shutter which presses up against its lower end, thus protecting the reticule from dust and moisture as completely as in the ordinary form of telescope. The construction may be likened to that of an ordinary telescope with the tube cut in two near the ocular, this end being passed through a hole through the middle of the objective.

Another matter of importance is this. It is evident that unless the plane of the reticule passes through one of the principal points of the objective, any change in the inclination of the apparatus will shift the zero point of the micrometer with respect to the vertical. This makes necessary a correction depending on the level readings—the very thing which we wish to avoid. For this purpose Dr. Hastings, who computed the curves of this objective, so designed it as to bring the first principal point in front of the upper surface, 0.155 inch. It was a simple matter to place the plane of the reticule at this same distance. These peculiarities introduced into the problem some technical and mechanical difficulties, all of which were successfully overcome, the optical performance being entirely satisfactory.

A solid cast-iron pillar, weighing several hundred pounds, formed the tube of the telescope. The focal adjustment is made by raising or lowering the mercury surface, this arrangement offering no difficulties.

As is usually the case with a new design, in part experimental, various unforeseen delays have occurred. All previous difficulties have apparently been overcome, and regular observations are now in progress. At present observations are carried on simultaneously with this instrument and the zenith telescope; four groups are employed as heretofore. In this program each group contains eight zenith stars to be observed with the reflex tube, and ten latitude pairs for the zenith telescope, with one wide pair for temperature investigation; the time required for these nineteen observations being on the average approximately two and one half hours. It is hoped that in the course of two or three years these observations may furnish data tending to throw light on a number of obscure problems.

The star γ *Cygni*, magnitude 2.5, culminates within less than one minute of the zenith of the instrument. Although at present it differs in right ascension from the sun by only $1^h\ 30^m$, it is an easy object to observe. There will be no difficulty in following it during the greater part of the year. As an indication of the performance of the instrument the latitudes resulting from a preliminary reduction of the observations made on this star are here given.

1904, Dec.	6,	$\phi = 39° 58' 1''.83$
	7,	1.95
	8,	1.85
	9,	1.86
	13,	1.81
	14,	1.79
	16,	1.84
	18,	1.92
	31,	1.79
1905, Jan.	1,	2.00

Variations of the Bright Hydrogen Lines in Stellar Spectra: ANNIE J. CANNON.

Stars whose spectra are of the Orion type, having also one or more bright hydrogen lines, form a most interesting peculiar class whose position in the scheme of stellar evolution is enigmatical. The Harvard photographs show that the bright hydrogen lines are variables in the following six of these stars, *η Centauri, κ' Apodis, υ Sagittarii, ε Capricorni,* J *Velorum* and 27 *Canis Majoris.* So far as known, no variation in the light of any of these stars has ever been observed, although the changes in their spectra point either to great atmospheric upheavals or to movements of two or more revolving bodies.

The most important changes in the spectrum of *η Centauri* may be summarized as follows: In 1897 all lines were dark and $H\beta$ was nearly as intense as $H\gamma$. In 1898 and 1899 $H\beta$ was very faint and appeared as a dark line superposed on a faint bright band. In 1901 a most striking change had taken place, for $H\beta$ had become a strong bright line, having considerable shift towards the violet when compared with the dark $H\beta$ present in 1897. $H\gamma$ was dark with a bright band towards the violet. Photographs taken in 1902 recorded the reappearance of the dark line on the edge of greater wave-length of bright $H\beta$, and both lines were of moderate intensity. In 1903 the spectrum was similar to that of 1898. The period of these changes is probably several years in length.

The changes in the spectrum of *κ' Apodis* are somewhat similar to those of *η Centauri.* It appears that both these stars are spectroscopic binaries, one component of each being a bright line star. The spectrum of *υ Sagittarii* presents another difficult spectroscopic problem, perhaps on the order of *β Lyræ.* The spectrum of *υ Sagittarii* always appears to be composite. The principal lines seem to be due to two bodies, one having a spectrum like *β Orionis* and the other like *ε Aurigæ.* The spectrum of *β Orionis* was strongly predominant on seven photographs, but frequently the two spectra seemed to be equally intermingled. Perhaps the most curious phenomenon is that on twenty-three photographs, on which the helium lines were very strong, those of hydrogen were unusually weak. $H\beta$ was invisible, appearing neither as a line of emission nor of absorption, while line 4,922 was clearly seen. $H\gamma$ and $H\delta$ were respectively much less intense than the adjacent helium lines at 4,387.8 and 4,120.5. It is possible that a third body, having bright hydrogen lines, might explain these appearances.

Eleven photographs of the spectrum of *ε Capricorni,* taken in 1903, showed $H\beta$ to be a faint but distinct bright line lying on the edge of greater wave-length of an equally faint dark line. On earlier photographs, $H\beta$ was dark and of varying intensity. Some faint lines, including several due to iron, are also subject to change in this spectrum.

It is possible that varying atmospheric conditions may account for the changes in the spectra of J *Velorum* and 27 *Canis Majoris.* On June 2, 1893, the dark $H\beta$ and $H\gamma$ in J *Velorum* had a fine bright line superposed. In the spectrum of 27 *Canis Majoris,* bright hydrogen was present in March, 1890, April, 1895 and October, 1897. Numerous photographs of both these spectra on other dates showed all the lines to be wholly dark.

It is evident that a large field of investigation lies open to the spectroscopist among these bright-line stars.

Variable Stars in Large Nebulous Regions: Henrietta S. Leavitt.

Since last March a special study of the distribution of groups of variable stars has been in progress at the Harvard College Observatory. As one result of this investigation, four hundred and fourteen new variables have been discovered and announced. Seventy-three of these are in Orion, one hundred and fifty-two in the Large Magellanic Cloud, fifty-seven in the Small Magellanic Cloud, one hundred and five in Scorpius, ten in Carina and seventeen in Sagittarius. The results of this study up to the present time may be summarized as follows:

First, as regards distribution, it has become evident that groups of variable stars are strongly localized. Of the ninety-nine confirmed variables at present known in the constellation of Orion, south of the equator, eighty-nine are within the limits of Bond's map of the region surrounding the Nebula of Orion, and of these all but four are found in less than half this area. The entire region thus finally limited is nebulous. The large number of variables discovered in the two Magellanic Clouds is in marked contrast with the small number found in the surrounding regions. The neighborhood of the Trifid Nebula in Sagittarius is noticeably poor in variable stars, and so also is the neighborhood of the nebula about η *Carinæ.* Yet these are two of the most densely crowded regions of the Milky Way. In Scorpius, after subtracting thirty-three variables which were found in the cluster Messier 4, there are still left more than four times as many variables as were found in an area in Sagittarius approximately equal in extent and far richer in stars.

Secondly, a certain order of brightness appears, on the whole, to prevail among the variable stars of each group, those in the central condensation of the Large Magellanic Cloud being the faintest, and those in Scorpius the brightest.

Finally, it is probable that different types of variability prevail in different regions. In both of the Magellanic Clouds, a large proportion of the variables appear to have very short periods, while in Scorpius the reverse may prove to be the case. Many of the variables in the Nebula of Orion remain faint during the greater part of the time, but occasionally show a striking increase of brightness. Whether these flashes of brilliancy occur regularly is not yet known.

The researches here described supplement the remarkable discovery by Professor Bailey, of large numbers of variable stars in clusters. They are similar to those carried on by Professor Wolf, of Heidelberg, who has announced lists of new variables in Orion, Aquila and Vulpecula. Evidently a further study of the distribution of groups of variable stars will be intensely interesting in its bearing upon the problems of stellar evolution.

Planetary Spectrograms: Percival Lowell.

These spectrograms were made by Mr. V. M. Slipher and the lantern slides of them by Mr. C. O. Lampland, both of the Lowell Observatory staff, and were presented by the director, Professor Lowell.

1. Solar spectrum, photographed November 30, 1903—59 dark lines can easily be counted between G and Hγ.

2. Spectrum of ϵ *Pegasi,* photographed

September 20, 1904—exposure $2^h\ 15^m$. Iron and chromium comparison spectrum. About 59 dark lines can be counted between G and $H\gamma$.

3. Spectrum of Venus, photographed March 9, 1903. This is one of the set from which Mr. Slipher determined the rotation of the planet not to be of twenty-four hours or thereabouts, but very long—iron comparison spectrum.

4. Spectrum of Mars, photographed March 7, 1903—iron comparison spectrum. One of the plates of the set made on Mars by Mr. Slipher to test the measure of precision of the Venus set. The Mars plates gave $25^h\ 10^m \pm$ for the planet's rotation. The true value is $24^h\ 37^m$. As the precision possible on Mars is only half that possible for Venus the results speak for the decisiveness of the Venus set.

5. Spectrum of Jupiter, photographed November 21, 1903—iron comparison spectrum. The tilt of the lines shows a rotation in $9^h\ 50^m \pm$, which is exactly the true rotation period as determined by Spots.

6. Spectrum of Saturn, ball and rings, photographed September 7, 1904, on a Cramer 'crown' plate—iron comparison spectrum. The tilt of the lines of the ball in one direction and that of the lines of the rings in the other are well shown, demonstrating that the rings are formed of discrete particles, as proved mathematically by Peirce in part and Clerk-Maxwell in whole and first shown spectroscopically by Keeler.

The spectroscope used in these researches was constructed by Brashear as powerful as possible, especially for the determination spectroscopically of the rotation period of Venus.

The Canals of Mars. An Investigation of Their Objectivity: Percival Lowell.

A new and striking proof of the objectivity of the double canals of Mars has recently come to me in a comparison of the width of the doubles obtained by Schiaparelli in 1888 and by me in 1903. The unintentional character of the corroboration is one of its strongest points. Not only at the time of my observations was his work not in my mind, but not even after the fact had I proposed to compare it.

The following table summarizes the results obtained in 1888 and in the May-June presentation of 1903.

CANALS DRAWN DOUBLE BY SCHIAPARELLI, 1888.

	Times Seen.	Width. °
Euphrates	4	5.1
Phison	4	3.9
Astaboras	3	2.9
Protonilus	4	2.2
Pierus	4	2.4

Canals drawn single by Schiaparelli: Astusapes, Python, Xenius, Rhysius, Apis, Typhon, Hiddekel, Callirrhoe, Deuteronilus.

Two canals, Arnon and Kison, were drawn convergent to the north.

CANALS DRAWN DOUBLE BY LOWELL, 1903.

	Times Seen.	Width. °
Euphrates	11	4 0
Phison	12	3.7
Astaboras	9	3.2
Protonilus	8	2.8
Pierus	2	2.1
Sitacus (faint)	12	3.6

Canals drawn single by Lowell: Astusapes, Python, Rhysius, Aroeris, Cadmus, Ægyptus. Hiddekel generally single, Callirrhoe generally a broad line.

Arnon sometimes convergent to the north, sometimes double. Kison suspicious of convergence to the north.

For both observers the direction of the canal had nothing to do with its single or double appearance.

The conspicuous doubles are the same in the drawings of both observers.

The conspicuous singles are the same in the drawings of both observers.

The Arnon and Kison are convergent in both and in the same direction.

Only the faint or very close doubles show differences at the two presentations.

The double canals, then, declare their own objectivity on three counts, each more compelling than the one before: (1) The fact of showing double, (2) the relative width of the double, (3) the absolute width of the double; and they do this precisely as a real object would, the certainty increasing with the ease of observation. The determination of the absolute width is very difficult, and here we find the probability for reality strong but not expressible; the relative width is easier to determine and the probability for reality is 24 to 1; lastly the determination of the fact of being double, the easiest observation of all, shows the probability that it is real to be 128 to 1.

Note on Three Solar Periods: Frank H. Bigelow.

The mean period of rotation of the solar photosphere at the equator is about 26.68 days, as determined by solar observations. There is a mean period of about 25.98 days indicated by terrestrial, magnetic and meteorological observations, which has been regarded as a period of solar rotation. The relative frequency of the solar prominences and the annual variations in the earth's atmosphere show that there is a short cycle of about 1,004 days. These are apparently related together by the equation,

$$\frac{1}{26.68}+\frac{1}{1004}=\frac{1}{25.98} \text{ (approximately).}$$

Some discussion is given of a possible physical cause for this condition, as found in the interior circulation of the sun's mass.

The Coordination of Visual and Photographic Star Magnitudes: John A. Parkhurst.

The importance of stellar photometry among the departments of modern astronomy arises from the fact that the magnitude of a star bears immediately on the star's physical condition and changes. That this is of growing importance is witnessed, among other things, by the numerous discoveries of new variable stars, over three hundred in the present year; showing that variability must be reckoned with as a factor in stellar evolution to an extent that would not have been imagined a decade ago. The relation lately shown to exist between stellar variability and sun-spot phenomena adds at once to the interest of the problem and the possibility of its solution.

The photometric catalogues published within the last few years by the Harvard and Potsdam observatories furnish a secure basis for visual photometry, their results agreeing reasonably well except the discordances arising from differences in the star colors. No such basis for photographic magnitudes now exists, therefore to be useful and intelligible, magnitudes must be reduced or reducible to the visual system. But the extension of photometric work demanded by the present needs of astronomy is possible only by photographic means; hence the pressing need of finding some method of harmonizing visual and photographic results for stars differing in type of spectrum and, therefore, in color. The usefulness of such a method will vary somewhat in proportion as it enables us to utilize the photographic magnitudes already obtained.

That the great accuracy of photographic methods applied to the astronomy of position has as yet no counterpart in the astronomy of magnitudes, is due to the one disturbing factor of star color. It is well known that a colored star will affect differently the eye and the photographic plate, but it is not so well appreciated that equal differences arise in the visual estimates of colored stars by different observers or by the use of telescopes of different apertures. The 'color correction' amounting to one or two magnitudes for a red star in the photograph, is no greater than the difference between the simultaneous Harvard and Rousdon visual estimates of the brightness of such stars. In fact, we find discrepancies of the same kind and similar in amount between different observers, different telescopes, visual and photographic results, and different brands of plates in photography. If the statement is made that no known relation exists between visual and photographic magnitudes, the retort can be made that a normal visual scale does not exist.

The advantages arising from the use of orthochromatie plates have long been recognized, but Scheiner dismisses them with the statement that they can never yield visual magnitudes. The suggestion was first (as far as I am aware) made by Schwarzschild that the differenee between the magnitudes of a colored star on ordinary and orthochromatic plates can be taken as a measure of the star's color. If this differenee is a function of the color it only remains to find the form of the function, and then complete allowance can be made for the effeet of color and that troublesome factor can be eliminated, making possible the reduction of photographic magnitudes to visual, or *vice versa*. Two methods are available for finding the form of the function. First, by trial on known stars of different color (spectral type). To fix our ideas, suppose, for example, that a star of color 5 on Chandler's decimal scale was 7.0 magnitude visually, but photographed 8.0 magnitude on an orthochromatic plate and 9.0 magnitude on an ordinary plate. For such a star the orthochromatic plate gives half the eolor eorrection. It is evident that by such experiments with standard stars of known magnitude and color, the form of the function can be found. This work is being done by the writer, under a grant from the Carnegie Institution, using Cramer isochromatic plates in connection with ordinary plates, on the 24-inch reflecting telescope of the Yerkes Observatory. Provisional results thus far obtained are very promising. An independent method which will also be used for finding the form of the function, consists in comparing the intensity curves of the spectra of stars of different types with the intensity curves of the solar spectrum on the two kinds of plates used. It is evident that the photographic effect is the integral of the product of these two curves.

If the objection is urged that the difficulty of coordinating the results obtained with different brands of ordinary and orthoehromatic plates, will be equal to the difficulty of harmonizing the visual and photographic systems, it may be met by the suggestion that any brands of plates used should be calibrated by observations of a carefully selected list of standard stars, including each spectral type.

No less important than the choice of plates is the kind of teleseope to be used. It seems to the writer that the reflector is the only telescope suited for this work, since by it the rays of all wave-lengths are brought to the same focus.

Emphasis is needed on two further points in regard to the adaptability of the reflector to this work. When extreme ratios of aperture to focal length are avoided, first, the field is very nearly flat; seeond, the action is very rapid, so that the work ean be extended to faint stars. This flatness of field has been denied, both from theoretical reasons and from so-called measures of reflcetor plates; but it should be stated that the theory is incomplete, not taking proper account of the distribution of light in the 'blurred' image; also that the measures published by Plummer and Poor were not made on the original negatives, and can not, therefore, be properly called measures. The only real measures so far published, to my knowledge, have been those of the Eros plates taken with the Crossley reflector, and measured at Columbia and Lick. A few of these measures discussed by Hinks showed distortions giving anomalous results near the edge of the plate, but these anomalies are matched on the plates taken at Algiers with the standard photographic refractor, and noticed on the following page of Hinks's paper. It should also be stated that the aperture ratio of the Crossley was large, about 1 to 6.

For this work a diaphragm twelve inches in diameter has been used on the 24-inch reflector, and as the focal length is 93 inches, the ratio is a little greater than 1 to 8. Allowing for the area cut out by the flat, the clear aperture of the mirror is equivalent to 10½ inches. The exposures have been timed to give good measurable images of all the stars on Hagen's charts which extend to twelfth or thirteenth magnitude; in good seeing this requires ten minutes with ordinary plates and fifteen minutes on the isochromatic plates. The magnitudes have been deduced by measurements of disk diameters, the increase per magnitude being nearly uniform and amounting to about 0.025 mm. As the diameters are measurable with a probable error of 0.001 mm., corresponding to 0.04 of a magnitude, the results are comparable with the best visual measures.

This work has some similarity to the spectral photometry of the Draper catalogue, each taking account of the intensity curve of the spectrum; but differs from it in two respects: It is not confined to the bright stars, but can reach to the faintest visible; also, taking account of the entire spectrum, its results will harmonize with visual magnitudes.

The Quadruple System of Alpha Geminorum: HEBER D. CURTIS.

The well-known binary star *α Geminorum* was pronounced by Sir John Herschel to be the largest and finest of the double stars in the northern portion of the sky. Measures, of a very rude character, were made of this pair as early as 1718 by Bradley and Pond, so that this system has been under observation for nearly two hundred years. In spite of this fact some of the elements of the orbit are still quite uncertain, particularly the eccentricity and the period. Values of the eccentricity have been derived, ranging from 0.32 to 0.80, with corresponding periods of 1,001 to 232 years. In recent years the distance between the two components has commenced to decrease, with the result that the elements have become rather more determinate, and Doberck (A. N., 3970) has recently expressed the hope that through this decrease in the distance it will be possible to fix the orbit with considerable accuracy within the next ten or twenty years.

Doberck has derived the following sets of elements, of which he regards the second as the most probable and most in agreement with recent measures.

Elements of Castor.

Ω	29° 29′	33° 56′	42° 34′
λ	84 44	82 26	118 41
i	73 3	63 37	61 56
e	0.7513	0.4409	0.2321
Period	268 years	347 years	502 years
T	1,936.65	1,969.82	1,963.30
a	7″.326	5″.756	6″.467

Retrograde.

In January, 1896, Belopolsky at Pulkova discovered that the fainter of the two stars forming this system is itself a rapid spectroscopic binary.* The period of this

* *Bull. Acad. St. Petersburg,* December, 1896. *Astrophysical Journal,* January, 1897. *Mem. Acad. St. Petersburg,* XI., 4, January, 1900.

component is very well determined, being close to 2.934 days. Belopolsky finds, however, certain irregularities in the observations of successive years which are best explained by the assumption that the line of apsides rotates in about 1,400 days.

Recent spectrograms taken with the remounted Mills spectrograph show that the brighter component is also a spectroscopic binary, and that the system of *α Geminorum* is in reality a quadruple one. Since the discovery of this interesting fact in November of this year a number of plates of both stars have been secured. At present fourteen plates are available for a rough preliminary determination of the period, which seems to be about 27 days. Two early plates of the bright component are rather poor, so that their value in determining the period is somewhat impaired and more plates will be necessary before a more accurate determination of the period can be derived.

Both stars are given in the Draper Catalogue as of type A, and in the later Harvard classification as type VIIIa. H *Gamma* is rather broad and has not been used in the measures. The line at λ 4,481 due to magnesium is very good and there are quite a number of other metallic lines, rather broad and quite faint in the spectrum of the brighter component, and somewhat easier of measurement in the fainter. Helium is apparently absent. There are a number of lines due to titanium and iron, most of the latter being enhanced lines; two lines seem to be due to chromium. With proper exposure (about sixteen minutes) from fifteen to twenty-five measurable lines are found. The total range in the radial velocity is about twenty-one kilometers, and the preliminary determination of the velocity of the center of mass of the system is approximately + 5 km. per second. The corresponding constant for the fainter component is given by Belopolsky in his latest paper as — 4.1 km. per second. It is well known that where the elements of the visual orbit of a binary and the relative radial velocities of its components are both known it is possible to derive an accurate value of its parallax. Assuming the relative radial velocity to be nine kilometers and using the period of 347 years and the corresponding elements which Doberck regards as the most probable, we find a parallax of 0″.03. Using the other orbits given above, however, we should get values differing widely from this. It is evident that such results are meaningless till the elements of the visual orbit are known more definitely.

In the star *α Geminorum* we have a well-established quadruple system, and it is hoped that the more detailed investigation which the writer has in progress will give a definite determination of the relative radial velocity of the two systems, so that with the improvement of the visual orbit we may in time have a relatively very exact knowledge of the distance, mass and orbital dimensions of this complex star.

Use of the Method of Least Squares to decide between Conflicting Hypotheses: Harold Jacoby.

In 1901 the writer published* a theorem concerning the application of least squares when it is necessary to choose between two different methods of reducing observations. The theorem was doubtless well known, but the writer was unable to find it in print. Since then, Mr. Midzuhara, of the Tokyo Astronomical Observatory, has written three interesting articles† in which, among other things, he gives a different proof of the writer's theorem, and also obtains another analogous one. The object of the present note is to point out a very important divergence between Mr. Midzu-

* *Astr. Jour.*, 514.

† *Astr. Jour.*, 521, 535, 568.

hara's conclusions and the writer's; and also to show how one of the former's most interesting results can be obtained in a manner different from that used by him.

The writer's theorem is: "Let there be given two series of observation equations as follows:

$$\left.\begin{aligned} a_1x + b_1y + c_1z + \dots + n_1 = 0, \\ a_2x + b_2y + c_2z + \dots + n_2 = 0, \end{aligned}\right\} (1)$$
$$\vdots \qquad \vdots$$
$$\left.\begin{aligned} a_1x + b_1y + c_1z + \dots + p_1w + \dots + n_1 = 0, \\ a_2x + b_2y + c_2z + \dots + p_2w + \dots + n_2 = 0, \end{aligned}\right\} (2)$$
$$\vdots \qquad \vdots$$

the equations being identical in the two series except for the addition of one or more new unknowns $w, \cdots$ in (2). Let each of these 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 $p_1, p_2, \cdots$, and even if these coefficients are assigned at random, $[vv]_1$, is always larger than $[vv]_2$."

The conclusion drawn by the writer from this theorem is as follows:

"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. 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."

In his paper in *Astr. Jour.*, 521, Mr. Midzuhara says: "This conclusion, perhaps, depends on the author's misapprehension of the principle of probability. For I believe that to compare the probabilities of the two solutions we must necessarily take

$$\frac{[vv]_1}{m-\mu_1} \text{ and } \frac{[vv]_2}{m-\mu_2}$$

where m expresses the number of observations, and μ_1 and μ_2 are the numbers of the unknown quantities in the first and second solutions, respectively."

In other words, Mr. Midzuhara takes as the criterion for deciding between the two solutions the quantity ordinarily called 'mean error of one equation,' instead of the sum of the squared residuals. When the number of unknowns in the two solutions is different, these two criteria may give opposite results; the one indicating the first solutions as the more probable, the other, the second solution.

It is evident that practise of astronomers varies in this matter. Mr. Midzuhara, for instance, and doubtless other astronomers, too, use $[vv]/m-\mu$ as the criterion. On the other hand, Bessel was in the habit of using $[vv]$. A good example is to be found in his classic paper on the parallax of 61 *Cygni*. He there* reduces his observations with parallax terms, and again without them. He decides in favor of the reality of his parallax terms solely on account of the diminution of $[vv]$; and not until after this is decided does he compute the mean error $\sqrt{[vv]/m-\mu}$. This quantity he calculates for the parallax solution only,

* *Astr. Nach.*, No. 366, p. 87.

not for both solutions. So far is he from using it as a criterion.

It would, indeed, appear that very simple reasoning indicates $[vv]$ as the right criterion. If we consider observation equations of the general form:

$$\phi(x, y, z, \ldots, n,) = 0,$$

the ordinary solution determines $x, y, z, \cdots$, so as to make $[vv]$ a minimum. If there exists a doubt as to whether the form of the function ϕ should be either ϕ_1 or ϕ_2, this fact simply transfers ϕ to the list of unknowns, and we must so determine $\phi, x, y, z, \cdots$, as to make $[vv]$ a minimum. We shall do this if we make two ordinary least squares solutions for ϕ_1 and ϕ_2, the only possible values of ϕ, and prefer that solution which gives the smaller $[vv]$. Since the other criterion may give an opposite result, that other criterion must be wrong.

It may be of interest to add to the above a remark concerning the attractive result obtained by Mr. Midzuhara in his equation (13).* This result is:

$$[vv]_1 - [vv]_2 = w^2 P_w, \qquad (13)$$

where w is the value of the new unknown, obtained in the solution of our equations (2) and P_w its weight from the same solution. Mr. Midzuhara gives a somewhat extended demonstration of this equation (13); it may, however, be obtained almost directly from a principle demonstrated by Gauss in 'Elementis Ellipticis Palladis.'† It is there shown that if μ be the number of unknowns, and if the normal equations are solved by the Gaussian method of elimination:

$$[vv] = [nn \cdot \mu],$$

where $[nn \cdot \mu]$ denotes the usual Gaussian auxiliary. In the present case, if there are μ unknowns in equations (1), and $\mu + 1$ in equations (2), we shall have, at the end of our Gaussian elimination:

$$\begin{aligned}[pp \cdot \mu]w + [pn \cdot \mu] &= 0, \\ &[nn \cdot \mu] \\ &[nn \cdot (\mu + 1)].\end{aligned}$$

But, according to Gauss's principle:

$$\begin{aligned}[nn \cdot \mu] &= [vv]_1, \\ [nn \cdot (\mu + 1)] &= [vv]_2,\end{aligned}$$

and, as usual:

$$[nn \cdot (\mu + 1)] = [nn \cdot \mu] - \frac{[pn \cdot \mu]^2}{[pp \cdot \mu]}.$$

Therefore:

$$[vv]_1 - [vv]_2 = \frac{[pn \cdot \mu]^2}{[pp \cdot \mu]}.$$

But:

$$w = -\frac{[pn \cdot \mu]}{[pp \cdot \mu]},$$

and:

$$[pp \cdot \mu] = P_w = \text{weight of } w,$$

so that:

$$[vv]_1 - [vv]_2 = w^2 P_w.$$

This is Mr. Midzuhara's equation (13).

* *Astr. Jour.*, 568.

† 'Werke,' Vol. 6, p. 22.

Tables for the Reduction of Astronomical Photographs: Harold Jacoby.

In 1895 the writer published a paper entitled 'On the Reduction of Stellar Photographs, with Special Reference to the Astro-Photographic Catalogue Plates.'* As indicated in the title, the method there described was intended primarily for the reduction of large series of plates made at the same declination. But ordinary stellar photographs intended for star-cluster catalogues, solar or stellar parallax, etc., usually involve so few plates of a single declination that it is not economical to prepare the kind of special tables suitable for a photographic catalogue of the whole heavens. Moreover, Contribution 10 of the Columbia Observatory has long been out of print, so that it is now impossible to supply copies to those asking for them.

* 'Contrib. from the Obs. of Columbia Coll.' No. 10; and in French, *Bull. Com. Perm.*, Tome III.

For these reasons, the writer has prepared the present modification of his method, and has added tables suitable for the reduction of isolated groups of plates made at any declination distant more than 15° from the pole.

The tables will appear in a short time as one of the Columbia 'Contributions.'

Recent Researches of the Henry Draper Memorial: Edward C. Pickering.

A photograph was shown of the spectrum of λ *Cephei,* which has a spectrum closely resembling that of ζ *Puppis* and contains the second series of lines probably due to hydrogen. A method of observing occultations photographically was explained and a printed enlargement of a photograph of the emersion of η *Virginis,* on December 28, 1904, was shown, which had been taken by Mr. Edward S. King. A rotary motion was given to the plate-holder so that the star gave a continuous trail, the time being indicated by a motion given to the plate at regular intervals. It appeared that the star increased in light during emersion for about a third of a second. The principal portion of the paper was devoted to the study of the distribution of the stars according to their spectra. The results were based upon an examination of the Draper plates by Mrs. Fleming. About 6,000 plates have been inspected, each showing on the average the spectra of a thousand stars, with small dispersion, and on these all that were peculiar were noted. Using a larger dispersion, about thirty thousand stars have been classified and catalogued. Visual counts of the number of stars in different parts of the sky have little value owing to the uncertainty of the magnitudes. The same might be said of a classification of photometric magnitudes of the stars taken as a whole. It was shown that stars of each class of spectrum should be considered by themselves, as the distribution differs widely. Thus, the Milky Way appears to consist wholly of stars of the first type. The helium or Orion stars have a different distribution, forming a Milky Way of their own, mainly in Orion and Argus. It was shown that the classification of the variable stars, proposed by the writer in 1880, was confirmed by their spectra, and that the latter formed a means of determining the class, in some cases, even better than the light curve.

Note on Two Variable Star Catalogues: J. G. Hagen.

Father Hagen presented to the meeting some specimen pages of two Catalogues of Variable Stars, now in preparation, one by the Astronomische Gesellschaft and the other by Professor E. C. Pickering. Of the former catalogue seven pages had been printed for presentation at the astronomical congress in Lund, last September. A copy had been sent to Father Hagen in time for the Philadelphia meeting, but Dr. Mueller's report at Lund came, unfortunately, too late. For this reason only those features of the catalogue could be mentioned that presented themselves to the reader of these seven pages.

More definite explanations could be given on the other catalogue, since Professor Pickering was himself present, and had shown one specimen page previously to several friends. His catalogue will be a 'Bibliography of the Variable Stars,' with the lists of the known maxima and minima, and the sources from which they were taken. Father Hagen brought out the fact that the two catalogues will supplement one another. The catalogue of the Astronomische Gesellschaft will give exact positions and elements of light variations, with very condensed references to all accessible publications, on each variable star. Professor Pickering's 'Bibliography' will give fuller details of the spectra of the variables stars from the rich material at the Harvard College Observatory, and will put the lists of known maxima and minima in the convenient shape of tables. While the former catalogue will make a volume of about 500 pages (quarto size), the latter will only have one third of this bulk. Both catalogues will be a very valuable accession to our literature on this subject.

Useful Work for a Small Equatorial—A Proposed Discussion.

The discussion was opened by Professor Edward C. Pickering. He stated that measurements of wide double stars might be useful, but that the positions of stars much more than 5″ apart could be better determined by photography, while closer stars required a large telescope. The brightness of stars can now be readily and inexpensively determined with a wedge photometer, and the relative light of the components of close doubles by a polarizing photometer. The Herschel-Argelander method could be usefully applied to faint stars, especially to the components of coarse clusters, and to Durchmusterung zones, inserting all stars brighter than a fixed magnitude. Variable stars of long period can be usefully followed by inexperienced observers, since the range is large. Observations of suspected variables, of Algol, and other short period variables, are likely to be of little value, except when made by observers having long experience. But little useful work could be done with spectroscopes attached to small telescopes. A search for new stars in the Milky Way, and an examination of known nebulæ to see if they are gaseous, as was, perhaps, first done by Col. John Herschel, might prove of value. Observations of Jupiter's satellites, comets, sunspots and solar prominences were also mentioned as useful fields of work for instruments of this class.

Frank B. Littell,
For the Council.

SCIENTIFIC BOOKS.

Die Moore der Schweiz, mit Berücksichtigung der gesamten Moorfrage. Von Dr. J. Früh und Dr. C. Schröter. (Beiträge zur Geologie der Schweiz, herausgegeben von der geologischen Kommission der Schweiz, naturforschenden Gesellschaft, geotechnische Serie, III Lieferung.) Bern, 1904. 4°, pp. xviii + 751. 45 text-cuts, 4 plates and a map.

Probably every person seriously interested in peat-bogs (or, as we may better call them, peat-moors), whether it be from a geological, a phyto-ecological or an economic standpoint, has known that the present work was in preparation and has eagerly anticipated its appearance. The authors are well known as among the foremost authorities upon the subject, and their work now before us fully satisfies our high expectations. While primarily devoted to the study of the Swiss moors, the authors nevertheless discuss every question also from the general or world standpoint, so that the work as a whole is in reality a study of peat-moors based upon those of Switzerland as types. It is divided into two parts, a first devoted to Moor-questions in general (435 pages), and a second given to a systematic description of those of Switzerland (310 pages). Under the first part is discussed, the general nature and place of moors, peat-building plant-groups (a modern ecological study), peat and its nature, geology of moors, geographical distribution of moors, a geomorphological classification of the moors of the world, nomenclature in relation to physical features, agricultural conditions of the Swiss moors, post-glacial vegetation history and its reconstruction through moors. Every chapter is characterized by exhaustive but clear treatment, by copious citation of literature, including that of this country, and by appropriate illustration. Among the illustrations are many of those diagrammatic vegetation cuts now coming into vogue in ecological works, while the plates include two typical photographic moor-scenes, of which we could wish there were many more. It is impossible here to particularize farther, and it must suffice to say that this work is incomparably the most exhaustive, authoritative and generally excellent treatise upon its subject which has yet appeared, and that it must form the foundation-work for all future studies upon matters connected with peat-moors.

W. F. Ganong.

SCIENTIFIC JOURNALS AND ARTICLES.

The January number of the *Botanical Gazette* contains a paper by Rodney H. True and C. S. Oglevee giving the results of studies on the effect of such insoluble substances as sand, starch grains, filter paper, etc., upon the toxic action of electrolyte and non-electrolyte poisons in aqueous solution. It appears that the insoluble body adsorbs the poison solute, thus diminishing the effective concentration of the latter as though it were taken out of solution.—Burton E. Livingston describes the types of soil and of vegetation in the north-central part of the southern peninsula of Michigan (Roscommon and Crawford counties), and discusses the influence which the soil has in determining the distribution of the various plant societies. He concludes that the amount of soil moisture, determined largely by fineness of soil particles, is the main controlling factor here.—A. D. E. Elmer describes a number of new and noteworthy Californian plants.—Edgar W. Olive discusses the morphology of *Monascus purpureus*, taking up the accounts of Barker and Ikeno and giving certain results of his own observations.—B. M. Davis discusses fertilization in Saprolegniales based upon a recent paper by Trow; and also the sexual organs and sporophyte of Rhodophyceæ based upon a recent paper by Wolfe.

The Journal of Nervous and Mental Disease for January opens with a paper by Dr. F. X. Dercum, giving an exhaustive and careful report of three cases, one being illustrated, which bear upon the question of the relation of syphilis to spastic spinal paralysis and also indirectly upon the question of Erb's form of spinal syphilis. Dr. S. D. Ludlum contributes an article on the 'Possible Relationship of Neuro-fibrillar Changes to Insanity.' He summarizes the literature bearing on the subject, and reports a series of experiments conducted at Friends' Asylum which leads to the hypothesis of a close relationship between fibrils and mental manifestations. An interesting case of tumor of the occipital lobe with an unusual clinical history is reported by Dr. Philip Zenner; also one of carcinoma of the spine following carcinoma of the breast, the spinal disease being characterized by a phenomenally long course, possibly due to removal of the ovaries some four years before the patient's death. The October meetings of the New York Neurological Society and the Boston Society of Psychiatry and Neurology are reported. The 'Periscope' for the month contains abstracts of the following journals: *Monatsschrift für Psychiatrie und Neurologie, Brain, Neurologisches Centralblatt, Revue de Psychiatrie et de Psychologie Expérimentale, Centralblatt für Nervenheilkunde und Psychiatrie, American Journal of Insanity, Journal de Neurologie, Archives de Neurologie,* and selected articles from miscellaneous periodicals. The books reviewed in this number are 'Epilepsy and its Treatment,' by Dr. W. P. Spratling; 'La Mimica del Pensiero Studi e Ricerche,' by Dr. Sante de Sanctis; two volumes of 'The Doctor's Recreation Series,' edited by C. W. Moulton; 'Manuel pour l'Etude des Maladies du Système Nerveux,' by Dr. Maurice de Fleury; 'A Manual of Psychology,' by G. F. Stout; 'Trattato delle Malattie Mentali,' by Professor E. Tanzi; 'Lehrbuch der Nervenkrankheiten für Aerzte und Studierende,' by Professor H. Oppenheim; 'Essentials of Nervous Diseases and Insanity,' by Dr. J. C. Shaw; 'Nietzsche,' by P. J. Möbius; 'Mental Defectives, their History, Treatment and Training,' by Dr. M. W. Barr, and 'The Physician's Visiting List for 1905–1906.' The issue closes with two pages of 'News and Notes.'

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF GEOLOGY AND MINERALOGY.

At the meeting of the section held on February 6 the following papers were read by title:

Moissanite, a Carbon Silicide from the Cañon Diablo Meteorite: George F. Kunz.

On Zirkon from Lawton, Oklahoma: George F. Kunz.

On Monazite Sand from Idaho: George F. Kunz.

A paper entitled 'The Serpentine and Associated Asbestus Minerals of Belvidere Mountain, Vermont,' was presented by V. F. Marsters, of Columbia University.

Belvidere Mountain lies approximately along the line between the counties of Orleans, Lamoille and Franklin. It is a sharp crested ridge with a maximum elevation of some 2,100 feet above Eden Corners at its southern termination. Three topographic elements are prominent, a sharp crested ridge forming the upper 900 feet of the mountain, a crescentic plateau with a flat top 1,200 feet above the valley floor and rimming the end of the mountain, and lastly a steep lower slope composing the foot of the plateau and extending to the valley bottom.

The upper part with steep slopes is composed of amphibolite. In addition to the hornblende which makes up seventy-five per cent. of the rock, there is also present an inconsiderable amount of epidote and a non-pleochroic colorless mineral regarded as zoisite, together with magnetite and pyrite. Towards the base, garnet becomes a prominent constituent, sufficient to make a well-defined garnet zone. In nearly all cases observed, the garnet is largely altered to penninite, a variety of chlorite. Along the garnet zone the hornblende has also undergone marked alteration in part to serpentine. The nose-like projection forming the plateau is composed of serpentine. In this rock occur the so-called asbestus deposits recently prospected and worked for this product. In thin sections the serpentine appears to be made up largely of a felty and fibrous mass, apparent only under cross nicols. It is typical fibrous serpentine. In thin sections from the upper part of the plateau and in close proximity to the overlying amphibolite, there appear shredded masses presenting the original structure of hornblende as seen in the amphibolite, but mineralogically altered to a fibrous mass with the optical characteristics of anthophyllite. It is not improbable, moreover, that a portion of the hornblende has altered to tremolite. These fibrous constituents form the so-called 'slip-fiber.'

The serpentine belt has also been subjected to peculiar faulting and crushing. The cracks thus produced, even on a microscopic scale, have been filled with these fibrous constituents, and then the whole mass submitted to further slipping. This has caused the slickensiding phenomena on the fracture planes and a consequent stretching of the fibrous content; hence the term 'slip-fiber.' 'Cross-fiber' or true chrysotile is to be found in this area. It is best developed along lines of maximum fracture and minimum lateral thrust. There appears to be two bands of maximum fracture, one extending along the upper portion of the plateau and not far from the garnet zone, the second along the foot of the plateau and best shown on the property of Judge Tucker.

The next paper was by Dr. Charles P. Berkey, on the 'Interpretation of Certain Laminated Clays with their Bearing upon Estimates of Geologic Time.'

Laminated clays of glacial and post-glacial age are abundant in many districts of the northern states and Canada. They are especially abundant about the head of Lake Superior where their origin is intimately related to the closing fluctuations and final withdrawal of the Wisconsin ice sheet.

One of these deposits, at Grantsburg, Wis., exhibits a remarkable uniformity of structure and is so clearly bounded by other accumulations of known significance that its history is readily interpreted. From a detailed analysis of the laminated structure it is argued that this deposit was about 1,700 years in accumulating.

A like interpretation of the similar isolated deposits following the retreating ice sheet would give data for time estimates from an entirely new standpoint. In some areas laminated clays occupy interglacial position and it may be possible to apply the same method to them.

The last paper of the evening was by Professor A. W. Grabau, on the 'Evolution of Some Devonic Spirifers.' *Spirifer mucronatus* (Conrad) is a Linnæan species comprising a large number of mutations. A remarkable fact is that all mutations pass through a mucronate stage such as is characteristic of the adult mutation after which the species is named. (The term *mutation* is here used in the sense in which it was originally proposed by Waagen, and not in that in which it was subsequently used by de Vries, *i. e.*, for the result and not for the process.) A still earlier stage in development (nepionic) shows the non-mucronate features of the ancestral species similar to *S. duodenarius* of the Onondaga. The mucronate feature is carried to excess in a number of mutations of the Lower Hamilton group. It is especially persistent in the Michigan region. This type of outline is accompanied by a rib in the median sinus and a depression in the fold. In Ontario the primitive mucronate type gives rise upward to a number of mutations which are especially characterized by progressive increase in height without corresponding lengthening of the hinge. The median plication and depression quickly disappear.

Acceleration and retardation in development are the chief principles which explain the development of the great number of mutations. For the principle of retardation the term ***bradygenesis*** (from βραδύς, slow) was proposed, corresponding to the term *tachygenesis* proposed by Hyatt for acceleration.

In the New York province the primitive mucronate type gives rise to high and short-hinged mutations, but these retain the median rib and depression. In form these are tachygenetic; in respect to the surface features, bradygenetic. In the arenaceous beds of the later Hamilton in eastern New York, a mutation with many ribs and moderate mucronations exists. This is in many respects a bradygenetic type. Side by side with extremely accelerated or tachygenetic types in all horizons (*i. e.*, very short-hinged, non-mucronate, high and thick mutations) occur slightly retarded or bradygenetic types which retain in the adult the mucronate character which is typical of the young of all the mutations.

A. W. GRABAU,
Secretary.

COLUMBIA UNIVERSITY.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 596th meeting was held February 4, 1905.

Mr. J. F. Hayford, chief of the Computing Division of the Coast and Geodetic Survey, reported briefly on the completion of the reductions of the leveling between Seattle and several points on the Atlantic coast; the apparent difference of level between the two oceans is 187 mm., 0.6 foot. The levels run at Nicaragua gave a difference of zero.

Mr. Bernard R. Green then spoke on 'Public Buildings in Washington,' presenting many lantern views, and outlining the problems that have been forced on his attention during the many years he has been connected with the erection of such buildings. Attention was called to the peculiar far-sighted plan of the city, with its two centers at the Capitol and White House, marked by monumental buildings. The majority of the government buildings, he held, should be expressive of their use and so be of the workshop or office type rather than monumental, and should be well scattered. The future buildings of the monumental class will probably be of the modified classical type, massive, of stone, and relatively low, *e. g.*, eighty feet. The cost of these is high; the State, War and Navy Building cost $1.06 per cubic foot, the Library of Congress sixty-three cents, including decorations. Buildings of the other class may be of the columnar type, a steel skeleton structure which carries the outer walls, and costs twenty-five to thirty cents per cubic foot.

Mr. S. W. Stratton, director of the Bureau of Standards, then spoke on 'The Architectural and Engineering Features of Scientific Laboratories,' exhibiting many views of such buildings and especially the new ones of the Bureau of Standards. The most important conditions to be secured are freedom from vibration and jars, and perfect control of the ventilation and temperature of the rooms. An excavated basement is a great source of trouble; the heating and power-plants and machinery should be in a separate building. Substantial reinforced concrete floors render piers unnecessary in the first story, while in the second story wall-brackets are generally better than floor supports for apparatus. Numerous other details were considered.

The subject of stability was further discussed by several of the physicists and astronomers present.

Charles K. Wead,
Secretary.

DISCUSSION AND CORRESPONDENCE.

RECENT WASHINGTON RHIZOBIA EXPERIMENTS.*

In 1902 Dr. Geo T. Moore published a paper in which he gave a brief outline of the history of the study of the free nitrogen-assimilating microbes of leguminous plants.† In this paper the author outlines a method for increasing the nitrogen-assimilating power of rhizobia by growing them upon artificial nitrogen-free media, which is said also greatly to increase their tubercle-forming power. According to the paper by Grosvenor, Dr. Moore has continued his experiments along the same line and has patented the process, giving the patent rights over to the government for the sole benefit of the farmer. It is stated that by the use of these nitrogen-hungry rhizobia the yield of any leguminous crop may be increased very greatly (from 40 to 400 per cent.). The results are said to be far superior to those obtainable from the use of the 'Nitragin,' patented by Nobbe and Hiltner of Germany. Instead of bottling the cultures (of nitrogen-hungry rhizobia) in a dry pulverulent state, as did Nobbe and Hiltner, Dr. Moore infiltrates absorbent cotton with the cultures and dries it, whereupon it is ready for shipment to the farmer, at a nominal cost.

If the claims of the paper can be verified by further tests, Dr. Moore deserves credit for having accomplished a work which will prove to be of great benefit to farmers. It will of course not do away with the necessity of crop rotation.

It is regrettable that Dr. Moore did not see fit to contribute the article himself and that it did not appear in some scientific publication rather than a literary magazine. This is not at all intended as a criticism of Mr. Grosvenor's presentation of the work done by Dr. Moore, only the custom prevails for those who do the actual scientific work to also present it to the world first-hand, nor are we in the habit of looking for reports of research work in publications devoted almost wholly to fiction.

Albert Schneider.

* Gilbert H. Grosvenor, 'Inoculating the Ground: A Remarkable Discovery in Scientific Agriculture,' *The Century Magazine*, **68**: 831–839 (October), 1904.

† Geo. T. Moore, 'Bacteria and the Nitrogen Problem,' Year-book of the Department of Agriculture, pp. 333–342, 1902.

SPECIAL ARTICLES.

A NEW CODE OF NOMENCLATURE.

In *The Condor* for January, 1905 (Vol. VII., pp. 28–30), is an abstract of a new code of nomenclature, "which will shortly appear under the joint authorship of Doctors Jordan, Evermann and Gilbert, * * * entitled 'Nomenclature in Ichthyology. A Provisional Code Based on the Code of the American Ornithologists' Union.'" It is said:

> The recent preparation of numerous papers in systematic ichthyology has necessitated the reconsideration of many problems of zoological nomenclature, and as some of these are not covered by any canon in any recognized code, and again, as certain canons in the best considered of the various codes of nomenclature, that of the American Ornithologists' Union, are not available in the study of fishes, we have ventured to draw up a code for our own use in ichthyology. * * * The different canons in this code are based on those composing the code of the American Ornithologists' Union, and so far as possible the language of that admirable document has been followed. We have, however, omitted certain matters which may be considered as self-evident, and we have omitted all reference to groups of higher than family rank.

The points in which the ichthyological code differs from the ornithological are then stated; the text of these parts of the new code is given apparently in full, and relates to six of the canons of the earlier code. As the perfect code has not as yet been devised, all improvements on preceding codes should, of course, be welcomed, but changes from well-established methods of procedure should carry convincing evidence that they are improvements in order to secure adoption.

Not many months ago the American

botanists issued a new 'Code of Botanical Nomenclature,'* they having found the Paris Code of 1867 out of date and unsatisfactory. This code does not depart essentially from the A. O. U. Code, but on some points it is fuller and more explicit, and at the same time more concise. As said in another connection:

> The A. O. U. Code was a pioneer in innovations which have now become very generally accepted, but which then (1886) required argument and extended illustration. * * * Provision is made for a few points not covered by the A. O. U. Code, but the spirit and principles of this code are * * * closely followed. * * * †

In the Ichthyological Code the new rulings principally relate: (1) To competitive specific names published simultaneously; (2) to competitive generic names published simultaneously; (3) to the determination of a generic type in cases where no type has been indicated by the author; (4) to the admissibility of orthographic variants of generic names.

The primary purpose of all codes of nomenclature is stability of names; how best to accomplish this under complicated conditions is still an open question. The points on which leading authorities still differ are mainly those above stated, and respecting which a new departure is proposed. These may be taken up briefly in sequence.

1. *Specific Names Published Simultaneously.*—"Canon VI. Of competitive names otherwise tenable, given by the *same*‡ author, that one is to be preferred which stands first in the text. In case of competitive names otherwise tenable, given by *different* authors of the same actual date, so far as ascertainable, the one standing on the earlier page of *its publication* must be chosen."

To this ruling there is no objection, provided authors will uniformly adhere to it. This method was considered in framing the A. O. U. Code, but was deemed too arbitrary, as the author publishing a large book, with new names introduced in the middle portion or toward the end, would have no chance against the man publishing new names in a small book or in a short pamphlet, however superior his accompanying diagnoses might be. For this reason the A. O. U. Code (Canon XVII.) proposed alternatives, perhaps better applicable in ornithology than in some other branches of zoology. Thus preference is to be given, first, to the name founded on the male to that founded on the female; second, to that founded on the adult to that founded on the young; third, to that founded on the nuptial condition to that on the pre- or postnuptial condition.

2. *Generic Names Published Simultaneously.*—"Canon VII. In case of competitive generic names otherwise tenable, published in the same work, preference shall be given to the one standing first in the work. Of competitive generic names of the same actual or ostensible date (no exact date being ascertainable) given by *different authors,* that one is to be taken which is proposed on the *earlier page of the volume in which it appears.* When the same generic name is given to two distinct genera of animals at the same date (as far as ascertainable), the name appearing on the earlier page shall be deemed to have precedence."

Here again the ruling is rigidly arbitrary as between earlier and later pagination in *different publications.* The A. O. U. Code (Canon XVIII.) provides, under such contingencies, that: "1. A name accompanied by the specification of a type takes precedence over a name unaccompanied by such specification. 2. If all, or none, of the genera have types indicated, that generic name takes precedence the diagnosis of which is most pertinent." Here comes in the element of personal decision as against arbitrary rule, but the cases are extremely few where the proper course of action is not evident.

3. *The Determination of Generic Types.*—Canon X. of the Ichthyological Code relates to the fixing of the type of a genus, when no type has been indicated by the author. On no nomenclatorial question is there greater

* *Bulletin Torrey Botanical Club,* Vol. XXXI., No. 5, May, 1904, pp. 249–290.

† *Auk,* Vol. XXI., July, 1904, pp. 404, 405.

‡ The italics in these quotations are not in the original, but are used here to draw attention to special points.

diversity of usage or greater strenuosity of opinion than on this, although the tendency is, or was formerly, to follow one of two courses, either to take the first species as the type, or to determine the type by the principle of elimination, under certain reasonable restrictions. Of late the latter has been the course favored by the greater part of those systematists who have any special regard for rules of nomenclature. Two qualifications of the strict rule of determining the type by elimination have been widely accepted. One is that when a genus containing a number of species is divided, and the name of one of the species is chosen as the name of a new genus, the type of that genus shall be the species the name of which has been selected as the name of the genus—a perfectly logical, unequivocal proceeding, open to no reasonable objection.

A second exception is that of the A. O. U. Code, which provides that if a "genus contains both exotic and non-exotic species—from the standpoint of the original author—and the generic term is one originally applied by the ancient Greeks and Romans, the process of elimination is to be restricted to the non-exotic species." In this way the name is retained in nearly its ancient sense, and its transference to an irrelevant association is prevented. This exception comes in mainly, of course, in connection with Linnæan and Brissonian names, and is akin to that other rule, more or less tacitly held in the minds of many systematists, that the type of a Linnæan genus should be the best known European or officinal species originally included within it.

Canon XXI. of the A. O. U. Code is: "When no type is clearly indicated the author who first subdivides a genus may restrict the original name to such part of it as he may judge advisable, and such assignment shall not be subject to subsequent modification." This was not a new rule when announced by the A. O. U. in 1886, but was a part of the British Association Code originally promulgated in 1842, and reaffirmed by nearly every later code down to 1905, when three revolutionary ichthyologists came forward with the following as their Canon X.: "The type of a genus can be indicated by the original author only. * * * In every case, the determination of the type of a genus shall rest on evidence offered by the original author, and shall be in no wise affected by restrictions or modifications of the genus in question introduced by subsequent authors, nor shall the views or the dates of subsequent authors be considered as affecting the assignment of the type of a genus"! For such a reactionary and far-reaching proposition there should certainly be most convincing and satisfactory reasons, for it involves the overthrow of the consistent usage of the majority of systematists for the last half century, and invites at least temporary chaos in the place of what seemed permanent stability. The proposed new ruling should leave nothing to personal opinion, but should provide a rule of unquestionable applicability to all cases.

The argument for the new proposition is as follows: "It is believed that the principle that a generic name must be fixed by its original author is one of vital importance in nomenclature. All processes of fixing types by elimination or by any other resting on subsequent literature, lead only to confusion and to the frittering of time on irrelevant questions. The method of elimination can not be so defined as to lead to constant results in different hands. In general it is much more difficult to know to what types subsequent authors have restricted any name *than to know what the original author would have chosen as his type.* Most early writers who have dealt with Linnæan species have consciously or unconsciously encroached on the Linnæan groups rather than made definite restrictions in the meaning of the generic names."

In determining types and the tenability of names it is notorious that the systematist is and must be guided by what an author has done and not by what he may have intended to do, no matter how evident the unaccomplished intention may be. Rules, to be effective, must be rigidly enforced, regardless of personal preference in favor of some particular result. But the foregoing is a proposition to override rules and usages that have brought nomenclature to a reasonable condition of stability respecting a wide class of cases it is now proposed to reopen and subject to a new decision based largely on personal caprice. How is thus stated: "This may be done by direct statement [on the part of the author] that a certain species is a type species [a statement at present always respected and welcomed], the leading species, the 'chef de file,' or by other phraseology conveying the same idea [information always welcomed and in these days earnestly searched for and regarded]; it may be indicated by the choice of a Linnæan or other specific name as the name of a genus [also, as said above, recognized as a guiding principle], or by some statement which shall clearly *indicate an idea in the author's mind* corresponding in fact, if not in name, to the modern conception of the type of a genus. [Here, unfortunately, is the loophole for diversity of opinion as to whether the author had such an idea, and, if so, which of several species best meets the author's unexpressed conception. The decision of one author, in many instances, is likely, in the nature of the case, to be different from that of another, and the firm ground absolutely necessary for the proposed revolutionary procedure is wanting. Finally,] The type of a Linnæan genus must be, in the phraseology attributed to Linnæus, 'the best known European or officinal species,' included by that author within the genus [—an injunction already in force]."

We have here then several sound principles, which are not new but already in force, and a new proposition to enable an author who is in too much of a hurry or too indolent to find out what other authors have done under the principle of elimination toward fixing the type of a genus not otherwise determined, to fix the type offhand for himself on the basis of his own conception of what the author's idea was as to the type of his group, when, in a large proportion of cases, the author almost unquestionably never gave the matter a thought, or even entertained the idea of a type in the modern sense. What he may have thought is, in most cases, purely a matter of guesswork.

It is not quite true, as said in the new ichthyological code, that 'the method of elimination can not be so defined as to lead to constant results in different hands.' The results will vary somewhat with the experience and qualifications of the user of the method, if the conditions of the question are especially complicated and perplexing; but my experience has been that experts in such cases rarely reach different conclusions, especially if they are able to confer and discuss the case.

Canon XI. of the new code is in line with Canon X. It reads: "In case a genus requiring subdivision or modification contains as originally formed more than one species, and the author of the genus does not in any way clearly indicate the type, the first species named in the text by the author as certainly belonging to the genus shall be considered as its type." The enforcement of this rule would obviously, in some instances at least, lead to the gratuitous displacement of generic names which have long since reached a stable equilibrium under the principle of the determination of the generic type by elimination—the disturbance of simple cases universally accepted as settled, and, therefore, a well nigh wanton proceeding.

4. *The Recognition of Variants of Generic Names.*—Modern codes of nomenclature are practically unanimous in ruling that a generic name is untenable 'which has been previously used for some other genus in the same kingdom.' It has been so generally understood that 'name' is to be taken in the philological sense of a district word, that no ruling appears to have been deemed necessary as to what really constitutes a name in a nomenclatorial sense; but usage—one may almost say universal usage—shows that words varying merely by endings denoting gender, or compound words differing only in the connective vowel, or in which certain consonants, notably *l* and *r*, are used single or double, or, in certain words of Greek origin, the retention or elimination of the aspirate, or the use of *i* in place of *y*, or *vice versa*, etc., do not constitute distinct words or 'names' in a nomenclatorial sense. In other words, it is held that names of genera must be etymologically distinct, however similar they may be in form or pronunciation. This is affirmed by the uniform practise of systematists for a century.

In view of the discovery in recent years of the double employ of such a multitude of names in zoology, and the consequent wholesale elimination of those preoccupied though often of long currency; and also in view of the wide acceptance of the A. O. U. rule that names, generic or specific, 'are not to be rejected because of barbarous origin, for faulty construction, for inapplicability of meaning, or for erroneous signification,' and can be changed only to correct typographical errors, there has arisen a tendency to extend the rule of priority to the form of words, and to adopt names that vary to the extent of a single letter as tenable, whether etymologically the same or not. The first outbreak of this tendency, however, in code form, is furnished by the new ichthyological code, of which Canon XI., as given in *The Osprey*, reads:

"As a name is a word without necessary meaning, and as names are identified by their orthography, a generic name (typographical errors corrected) is distinct from all others not spelled in exactly the same way. Questions of etymology are not pertinent in case of adoption or rejection of names deemed preoccupied." The explanatory note following states that this canon "permits the use of generic names of like origin but of different genders or termination to remain tenable. All manner of confusion has been brought into nomenclature by the change of names because others nearly the same are in use. Thus the Ornithologists' Union sanction the cancellation of *Eremophila* because of the earlier genus *Eremophilus*, of *Parula* because of the earlier *Parulus*, and of *Helminthophaga* on account of *Helminthophagus*. On the other hand, *Pica* and *Picus* are allowed.* In ornithology this matter has been handled by a general agreement on the relatively few cases concerned. But in other groups, the matter is by no means simple, and every degree of similarity can be found."

* In this exceptional case of *Pica* and *Picus*, so often cited as an inconsistency, these two words are not gender forms of one name, but etymologically distinct words, used by the ancient classical writers as the names of two widely different birds, just as they are still used in ornithological nomenclature. Furthermore, it is a unique case.

This is the 'one-letter rule' *par excellence*, of which there have been mutterings of late in various quarters. Its promoters have good intentions, and high hopes, no doubt, that it will prove a panacea for an admitted evil. Possibly a beneficial compromise may result. When we reflect, however, that two forms of the same name, differing only by a single letter, sometimes occur in the same class, and often in the same branch, and that the same name when used for the same genus is current in several forms, differing sometimes more radically than by a single letter, and that, in many cases, the author of a name has himself used it at different times in all three genders, and sometimes in more than one gender in the same paper, and that many authors have in the past, and some still continue to exercise their own judgment or preference as to the correct gender of names, it seems hopeless to expect such a radical innovation to meet with general acceptance. By a slip of the pen or other lapsus even authors the most careful in such matters are sometimes caught using one form when they intended to use another. Many generic names have four to six variants that have been used for the same genus, while some of them may also have been current for wholly different genera. This seemingly should be enough to lay the goblin of the 'one-letter rule,' but it evidently is not, even with otherwise level-headed naturalists.

It would take too much space to illustrate the confusion and inconvenience that would arise from its serious adoption. For the full-fledged systematist illustration by concrete examples would seem to be superfluous.

It is a grievous inconvenience to have to abandon a long-current bird name or fish name for which one has almost formed an attachment as a household word, because some one has discovered that it had a prior use, perhaps only in a closely similar form, for some other genus of animals, perhaps insects, or mollusks, or cœlenterates, which had never before come within his horizon. In early days it was held that the same generic name could not be used for both animals and plants. The codes later ruled that there was no necessary connection between botanical nomenclature and zoological nomenclature, and that the use of a generic name in the one kingdom did not debar its use in the other. The different branches of zoology have now become so extended and specialized that the same rule of divorce might well be extended to the different branches of zoology. Little, if any, confusion could arise to ornithologists, or mammalogists, or ichthyologists, if a bird name, a mammal name, or a fish name should have currency for a genus of insects, or mollusks, or crustaceans, or echinoderms, or in each of these branches. If it could be agreed—and I am aware of no opposition—that the same generic name may hold good in different branches of the animal kingdom, but must not be used twice in the same branch (as in vertebrates, for example), it would result in the restoration of not a few familiar names that have had to give way under the animal kingdom priority rule, and lessen, if not quite do away with the present incipient call for an impracticable 'one-letter rule.'

5. *The Authority for Names.*—It is difficult to see the reason for Canon XXIX., which appears not to be published in full in *The Condor*. It is contrary to current usage and to other modern codes, that the authority for a name, given in manuscript on a museum label, is to be cited as the proper authority for such names when published by another author, who supplies the description and assumes the responsibility for the species. This canon says: "If a writer ascribes one of his species to some one else, we must take his word for it. Thus the manuscript species of Kuhl and Van Hasselt in the Museum of Leyden, although printed by Cuvier and Valenciennes, should be ascribed to Kuhl and Van Hasselt." This is not only a confusion of responsibility, but is bibliographically misleading, tending to throw the investigator off the track in looking for the original description of the species. Unless the publishing author endorses the supposed new species, he simply ignores the manuscript name and takes the responsibility for its suppression, just as in the other case he takes the responsibility for its publication and supplies the necessary description. If the author of a manuscript name supplies a description to accompany it, which only rarely happens, and the publishing author uses it as inedited manuscript, then the author of the name is also the author of the description and is to be cited as the authority for the species. In the other case, the name should be cited, in synonyny, as Cuvier (ex Kuhl, MS.), and otherwise as simply Cuvier. In the case of inedited matter, the citation would be Kuhl (in Cuvier, etc.), and otherwise as Kuhl. This, like the other points criticized above, is a singularly retrograde step.

J. A. Allen.

CURRENT NOTES ON METEOROLOGY.

METEOROLOGICAL RESULTS OF THE BLUE HILL KITE WORK.

The meteorological work done at the Blue Hill Observatory by means of kites has so often been alluded to in these 'Notes' that no comments on the value of this work are necessary at this time. The latest publication in this connection is a valuable report by H. H. Clayton, entitled 'The Diurnal and Annual Periods of Temperature, Humidity and Wind Velocity up to Four Kilometers in the Free Air, and the Average Vertical Gradients of these Elements at Blue Hill' (*Annals Astron. Obs. Harv. Coll.*, LVIII., Pt. I., 1904). Although some of the results herein discussed have already been brought forward in previous publications by Mr. Rotch and Mr. Clayton, the compact and careful summary now issued will be welcomed as giving a definite and complete presentation of the principal conclusions which have been reached through the well-known, extended and laborious series of scientific kite flights—a field of investigation in which Blue Hill has taken a front rank.

A study of the sources of error in the instruments and methods precedes the discussion of the results. Six possible sources of constant error are recognized as influencing the records, and also one source of error, not constant, which arises from temporary local differences of condition, and from the fact that the kites do not rise vertically. A glance at these preliminary pages will show with what extreme care the observations have been treated before being employed in obtaining any definite results. Mr. Clayton's thorough study of the sources of error must also bring up many doubts concerning the accuracy of results obtained by observers who exercise less care. It may be noted that, in Mr. Clayton's opinion, the excessive temperature gradients, greatly exceeding the adiabatic rate, which have several times been referred to in various publications, are probably due, for the most part, to the fact that the observations in question were not made simultaneously at the two levels (p. 14). Temporary local differences of temperature may also explain gradients which exceed the adiabatic rate (p. 15).

The interest which attaches to all reliable meteorological data obtained in the free air is so great as to warrant the inclusion, in the pages of SCIENCE, of the following summary of the most important points contained in Mr. Clayton's report.

Diurnal Period of Temperature at Different Heights.—On several occasions observations were obtained during many hours at heights of about 3 kms., but there was no evidence of any change of temperature due to a diurnal period. On June 18–19, 1900, for example, the temperature at a height of 2,900 ms. was recorded at intervals throughout twenty-four hours, and although there was a general fall under the influence of some general atmospheric change, there was no appreciable diurnal period (Fig. 3, p. 16), in spite of the fact that there were only a few cirrus clouds to obscure a small portion of the sky. At 1 km. there is a diurnal period of temperature, as is evidenced by numerous records, but with a tendency to a secondary maximum at night as well as by day. A marked feature is also a sudden fall of temperature after sunrise (about 9 A.M. in summer), the evidence from the movements of the kites at this time being to the effect that the diurnal convectional currents from the ground reach the kites then. This 'chilling' of the air at a height of about 1 km. is explained by Mr. Clayton as due to the rise of the ascending currents, on account of their inertia, to an altitude greater than their point of equilibrium. The ascending air is cooled by adiabatic expansion below the temperature of the air into which it penetrates; hence, at the tops of convectional currents of this kind, rising from the ground, there ought to be a belt of chilled air, above which there must be a higher temperature. Such an inverted temperature gradient is usually found above cumulus clouds. The diurnal change of temperature at the greatest altitude reached by the ascending currents must, therefore, be the opposite of that at the ground, *i. e.*, the temperature is lower by day than by night. The records of May 1, 1902, show clearly that an inversion of the march of the diurnal temperature does occur at the top of convectional currents rising from the warm ground (Fig. 4, p. 20), for while at 500 and 1,000 ms. the afternoon maximum is well marked, the temperature curve becomes inverted at 1,230 ms. At 2,000 ms. there is no perceptible diurnal period. This cooling at the tops of convectional currents begins nearer the earth's surface early in the morning, and reaches a maximum altitude about the warmest part of the day. The diurnal period of temperature at different heights is graphically summarized in Fig. 5 (p. 25), and verbally, on p. 29.

The Diurnal Period of Relative Humidity at Different Heights.—In general, the diurnal period in relative humidity is the inverse of that of the temperature at all levels up to and including 1,500 meters.

The Diurnal Period in Wind Velocity at Different Heights.—Mr. Clayton finds the well-known explanation, given by Espy and Köppen, of the diurnal variation in wind velocity only a partial one, for at night the air from 300 to 1,000 ms. above sea level does not merely resume a velocity of movement proportional to its height, but increases in velocity until its movement is more rapid than that of the air strata above or below the given level. Some other forces must, in Mr. Clayton's opinion, be called into play besides the retardation of the upper currents by ascending currents from below. It is suggested that, as the atmosphere is trying to maintain a mean velocity of flow having a constant value for the vertical section above any given point on the earth, if in any given part of the section the velocity is diminished, the air must flow faster in some other portion. This theory seems to explain satisfactorily the increased velocity between 300 and 700 ms. at night. The retardation of the air between 200 and 700 meters during the day, due to ascending currents, results in an increased velocity near the ground, and, as this is not sufficient compensation, also in the section of air between 1,000 and 2,000 meters. Hence, at the latter height, the velocity has a maximum by day and a minimum by night, as is the case at the ground.

Vertical Gradients of Temperature, Humidity and Wind Velocity.—At night the temperature rises with increase of altitude up to about 500 meters, and not until a height of over 1,000 meters is reached is the temperature in the free air as low as at the ground. During the day the temperature decreases with altitude nearly at the adiabatic rate for dry air up to 500 meters. Above that height the rate decreases, probably owing to frequent inverted gradients and to cloud formation. Between 500 and 1,500 meters the temperature decreases more rapidly by night than by day. The decrease is most rapid in summer and least in winter. During the day the rate of decrease diminishes to 2,000 meters, and then increases again. From 0 to 500 meters the rate is at a maximum by day and a minimum by night, but between 1,000 and 1,500 meters this condition is reversed, owing to the inversion of the diurnal period. An important point, noted on page 50, concerns the *mean vertical temperature gradient,* about which much has been written. Gradients which are the mean of two opposing conditions may not occur at all. The most frequent gradients which actually occur are (I.) an increase of temperature with increase of altitude, between $+0°.1$ and $+1°.0$ (C.) per 100 meters, and (II.) the adiabatic gradient, $1°.0$ (C.) per 100 meters. Some gradients exceeding the adiabatic rate have been observed, chiefly between 9 A.M. and 3. P.M. On the average, the relative humidity increases during the day up to about 1,000 meters, and then decreases to about 2,500 meters. During the night the relative humidity diminishes rapidly up to a height of 500 meters, and then more slowly, to a height of about 2,500 meters. Above 2,500 meters the relative humidity increases slowly again. There is a very rapid increase of wind velocity at night to a maximum at 500 meters, a slight decrease between 500 and 1,000 meters, and then an increase becoming more rapid with increasing height. There is a relatively rapid increase of wind velocity by day from the ground to 500 meters; a slower decrease from 500 to 1,500 meters, and almost no change from 1,500 to 2,000 meters.

R. DEC. WARD.

MEETING OF THE BRITISH ASSOCIATION IN SOUTH AFRICA.

THE British Association will hold its meeting this year in South Africa. In these exceptional circumstances, the general officers of the association requested the council to appoint a strong committee to cooperate with them in carrying out the necessary arrangements. This 'South African Committee' has held frequent sittings; and its work is so far advanced that the London *Times* is now able to make the following announcements:

Although the annual circular and program have not yet been issued, pending the receipt of information from South Africa, many members have already intimated their intention of being present at the meeting. The 'official party' of guests invited by the central executive committee at Cape Town, and nominated in the first instance by the council of the association, numbers upwards of 150 persons, comprising members of the council, past and present general officers and sectional presidents, the present sectional officers, and a certain proportion of the leading members of each section. To this list has yet to be added, on the nomination of the organizing committee, the names of representative foreign and colonial men of science, the total number of the official party being restricted to two hundred, including the local officials. It is hoped, however, that many other members of the association will also attend the meeting.

The presidents-elect of the various sections are as follows:

A. *Mathematical and Physical Science.*—Professor A. R. Forsyth, M.A., Sc.D., F.R.S.

B. *Chemistry.*—T. Beilby.

C. *Geology.*—Professor H. A. Miers, M.A., D.Sc., F.R.S.

D. *Zoology.*—G. A. Boulenger, F.R.S.

E. *Geography.*—Admiral Sir W. J. L. Wharton, K.C.B., F.R.S.

F. *Economic Science and Statistics.*—Rev. W. Cunningham, D.D., D.Sc.

G. *Engineering.*—Colonel Sir Colin Scott-Moncrieff, G.C.S.I., K.C.M.G., R.E.

H. *Anthropology.*—A. C. Haddon, M.A., ScD., F.R.S.

I. *Physiology.*—Colonel D. Bruce, M.B., F.R.S.

K. *Botany.*—Harold Wager, F.R.S.

L. *Educational Science.*—Sir Richard C. Jebb, Litt.D., M.P.

The vice-president, recorders and secretaries of the eleven sections have also now been appointed.

In view of the numerous towns to be visited by the association, and in which lectures or addresses will be given, the number of lecturers appointed is much larger than usual. The list of these, as at present arranged, is as follows:

Cape Town.—Professor Poulton, on Burchell's work in South Africa; and Mr. C. V. Boys, on a subject in physics.

Durban.—Mr. F. Soddy, on radioactivity.

Maritzburg.—Professor Arnold, on compounds of steel.

Johannesburg.—Professor Ayrton, on distribution of power; Professor Porter, on mining; and Mr. G. W. Lamplugh, on the geology of the Victoria Falls.

Pretoria (or possibly Bulawayo).—Mr. Shipley, on a subject in zoology.

Bloemfontein.—Mr. Hinks, on a subject in astronomy.

Kimberley.—Sir William Crookes, on diamonds.

As the wish has been conveyed to the council from South Africa that a few competent investigators should be selected to deliver addresses dealing with local problems of which they possess special knowledge, a geologist, a bacteriologist and an archeologist have been invited to undertake this work, involving in two cases special missions in advance of the main party. Whilst Colonel Bruce, F.R.S., will deal with some bacteriological questions of practical importance to South Africa, Mr. G. W. Lamplugh (by the courtesy of the Board of Education) will be enabled to investigate certain features in the geology of the Victoria Falls, particularly as regards the origin and structure of the canon; and Mr. D. R. MacIver, who is at present exploring in Nubia, will proceed in March to Rhodes in order to examine and report on the ancient ruins at Zimbabwe and also Inyanga.

Most of the officials and other members of the association will leave Southampton on July 29 by the Union-Castle mail-steamer *Saxon,* and arrive at Cape Town on August 15, the opening day of the meeting; but a considerable number will start from Southampton on the previous Saturday, either by the ordinary mail-boat or by the intermediate steamer sailing on that date.

The sectional meetings will be held at Cape Town (three days) and Johannesburg (three days). Between the inaugural meeting at the former and the concluding meeting at the latter town opportunities will be offered to members to visit the Natal battlefields and other places of interest. Subsequently a party will be made up to proceed to the Victoria Falls, Zambesi; and, should a sufficient number of members register their names, a special steamer will be chartered for the voyage home, *viâ* Beira, by the East Coast route, as an alternative to the return through Cape Town by the West Coast route. Thus all the colonies and Rhodesia will be visited by the association. The tour will last seventy days *viâ* Cape Town, or a week longer *viâ* Beira (all sea), leaving Southampton on July 29, and returning thither on October 7 or 14.

A central executive committee has been constituted at Cape Town, with Sir David Gill as chairman and Dr. Gilchrist as secretary, while local committees have been formed at Johannesburg and other important centers.

Professor G. H. Darwin, F.R.S., is the president-elect; and among the vice-presidents-elect are the following: The Right Hon. Lord Milner, the Hon. Sir Walter Hely-Hutchinson, Sir Henry McCallum, the Hon. Sir Arthur Lawley, Sir H. J. Goold-Adams, Sir David Gill and Sir Charles Metcalfe.

Sir David Gill, Mr. Theodore Reunert and others have taken a prominent part in the initial work. The South African Association for the Advancement of Science is cordially cooperating in the local organization, and will join with the British Association in attending the meeting.

The aim of the council has been to secure the attendance of a representative body of British men of science, including specialists in various lines of investigation; and that, along with the generous support of the people and authorities in South Africa, should go far to insure the success of the meeting and to stimulate local scientific interest and research.

JOINT ANNOUNCEMENT OF SUMMER FIELD COURSES IN GEOLOGY.

A pamphlet has lately been issued containing a brief account of the field courses in geology offered for the summer of 1905 by several universities in various parts of the United States. The number of courses offered and the professors, from whom information about them may be obtained, are as follows:

Intercollegiate Appalachian Course, Professor W. B. Clark.

University of Chicago, five courses, Professor R. D. Salisbury.

Columbia University, one course, Professor A. W. Grabau.

Harvard University, three courses, Professor J. B. Woodworth.

Johns Hopkins University, one course, Professor W. B. Clark.

University of Kansas, one course, Professor E. Haworth.

University of Minnesota, two courses, Professor C. W. Hall.

University of North Carolina, one course, Professor C. Cobb.

Ohio State University, one course, Professor C. S. Prosser.

Stanford University, two courses, Professor J. C. Branner.

University of Wisconsin, one course, Professor W. H. Hobbs.

In order to encourage the taking of summer field courses, the following colleges and universities have agreed to give credit, under certain conditions, to any of their students, who thus spent part of the vacation in scientific study:

Amherst College, University of Missouri, Beloit College, University of North Carolina, University of Chicago, Northwestern University, Colgate University, Oberlin College, Columbia University, Ohio Wesleyan University, Hamilton College, University of Rochester, Harvard University, Syracuse University, Johns Hopkins University, University of Toronto, University of Kansas, Vanderbilt University, Massachusetts Institute of Technology, Wesleyan University, McGill University, Western Reserve University, University of Michigan, Williams College, University of Wisconsin, University of Minnesota, Yale University.

SCIENTIFIC NOTES AND NEWS.

Professor Simon Newcomb celebrated his seventieth birthday on March 12. Professor Newcomb is at present engaged in an important investigation, under the auspices of the Carnegie Institution, for determining the elements of the moon's motion and for testing the law of gravity.

Professor Henri Moissan, of Paris, and Professor Wilhelm Ostwald, of Leipzig, have been elected corresponding members of the Berlin Academy of Sciences.

The following candidates have been selected by the council of the Royal Society to be recommended for election into the society: John George Adami, William Arthur Bone, John Edward Campbell, William Henry Dines, Arthur Mostyn Field, R.N., Martin Onslow Forster, Edwin S. Goodrich, Frederick Gowland Hopkins, George William Lamplugh, Ernest William MacBride, Francis Wall Oliver, David Prain, George F. C. Searle, Robert John Strutt and Edmund Taylor Whittaker.

Cambridge University will confer its doctorate of science on Dr. E. B. Taylor, F.R.S., professor of anthropology at Oxford.

On the occasion of the opening of the new public health laboratory of the Victoria University, Manchester, honorary degrees were conferred upon Professor Calmette, Lille University; Professor Perroncito, Turin University; Professor Salomonsen, Copenhagen University, and Captain R. F. Scott, R.N.

Professor K. Möbius has retired from the directorship of the Berlin Museum of Natural History. The position has been offered to

Professor H. H. Schauinsland, director of the museum at Bremen.

Dr. D. T. MacDougal, of the New York Botanical Garden, started on March 9 for Mellen, Arizona, and plans to make an examination of the deserts contiguous to that stream and the Gulf of California, and to obtain living material for the New York Botanical Garden. Mr. E. A. Goldman, of the Biological Survey of the Department of Agriculture, will accompany the expedition for the purpose of extending the field surveys of the department, and of obtaining material for the study of the fauna of the region.

Professor T. A. Jaggar, of Harvard University, will lead a geological expedition to Iceland during the summer. On or about May 25 the party will leave Boston for Liverpool. On June 10 it will leave Leith, Scotland, by steamer and will make a circuit of the island, stopping at places of interest on the coast, and finally landing at Reykjavik, whence a trip will be made northward over the island on foot or horseback. The party will return by steamer to Reykjavik and then to Leith after an absence of about forty days.

Mr. J. Maxwell Miller, Rhinehart scholar of the Peabody Institute, has modeled a bust in plaster of President Ira Remsen and presented it to the Johns Hopkins University.

A bust of Dr. William Osler, to be executed in marble by Mr. Hans Schuler, has been presented to the Johns Hopkins University. It is said that Dr. Osler will leave for England on about May 17.

Dr. Victor Hensen, professor of histology and embryology at Kiel, celebrated his seventieth birthday on February 10.

Mr. W. H. Maw has been elected president of the British Astronomical Association.

The Isaac Newton studentship of £250 for encouragement of study and research in astronomy has been conferred upon Mr. F. J. M. Stratton, B.A., scholar of Gonville and Caius College, Cambridge University.

The Prix Lacaze, of the value of 10,000 francs, awarded every four years by the Paris Faculté de Médecine to the author of the best work concerning tuberculosis, has been given to Dr. André Jousset.

Dr. Alexander Macfarlane will give at Lehigh University a course of lectures on British mathematicians of the nineteenth century as follows:

April 7, 11:30 A.M.—'Sir George Biddel Airy (1801–1892).'

April 8, 11:30 A.M.—'John Couch Adams (1819–1892).'

April 11, 5:00 P.M.—'Sir John Frederick William Herschel (1792–1871).'

April 13, 5:00 P.M.—'Isaac Todhunter (1820–1884).'

April 14, 11:30 A.M.—'Duncan Farquharson Gregory (1813–1844),' 'George Green (1793–1841).'

April 17, 5:00 P.M.—'George Salmon (1819–).' Conclusion.

The secretary of war, the Hon. Wm. H. Taft, has accepted the invitation of the National Geographic Society at Washington to address the society on the Philippines. The address will be given during the first week of May and is the last of ten addresses on the far east which the National Geographic Society arranged for 1905. The other addresses are: 'China,' by Hon. John W. Foster, ex-Secretary of State; 'Japan,' by Baron Kentaro Kaneko, of the House of Peers of Japan; 'Russia,' by Hon. Charles Emory Smith, formerly minister to Russia and ex-Postmaster General; 'Manchuria,' by Col. W. S. Schuyler, who has recently returned after eight months with the Russian armies in Manchuria; 'The Evolution of the Russian Government,' by Dr. Edwin A. Grosvenor, of Amherst College; 'Recent Observations on the Russo-Japanese War, in Japan and Manchuria,' by Dr. Louis Livingston Seaman; 'The Japanese Side of the War,' by William E. Curtis; 'The Panama Canal,' by Rear Admiral Colby M. Chester, U. S. N., superintendent of the U. S. Naval Observatory; 'The Commercial Prize of the Orient and its Relation to the Commerce of the United States,' by Hon. O. P. Austin, chief of the Bureau of Statistics. These addresses are published in the journal of the society, *The National Geographic Magazine.*

MR. MALCOLM MORRIS was expected to deliver the Harveian lecture before the Harveian Society of London on March 9, the subject being some modern therapeutic methods in dermatology, with exhibition of cases treated by the X and Finsen rays.

DR. DAVID MURRAY, professor of mathematics and astronomy at Rutgers College from 1863 to 1873 and subsequently adviser to the imperial minister of education at Japan and secretary of the board of regents of the University of the State of New York, died on March 2, aged seventy-five years.

DR. AUGUST BORNTRÄGER, associate professor of chemistry at Heidelberg, has died at the age of eighty-five years.

HARVARD UNIVERSITY and New York University again unite with the Bermuda Natural History Society in inviting zoologists and botanists to spend six weeks in the temporary biological station located, as during the past two years, at the Flatts, Bermuda. It is expected that the date of sailing from New York will be July 1. Those who desire to take advantage of the opportunities offered by the station should send applications as early as possible, and not later than May 1, either to Professor E. L. Mark, 109 Irving Street, Cambridge, Mass., or to Professor C. L. Bristol, New York University, University Heights, New York City.

THE *Albatross*, of the Bureau of Fisheries, has returned to California after four months of deep sea explorations of the South Pacific, under the direction of Mr. Alexander Agassiz.

THE forestry department of the University of Michigan, through the kindness of Dean C. Worcester, secretary of the interior, Philippine Islands, who was a graduate of the university in 1889, has received a collection of herbarium specimens of the forest flora of the islands, which will form study material and assist in preparing some of the students of the forestry department for the Philippine Service.

AN expedition from Indiana University, in charge of John A. Miller, professor of mechanics and astronomy, and W. A. Cogshall, assistant professor of astronomy, will go to Spain to observe the total solar eclipse that occurs on August 30. At some point in northeastern Spain, on a favorable site chosen by Professor A. F. Kuersteiner, of the department of romance languages, who is now in Spain, they will install their instruments. This temporary observatory will include a horizontal photographic telescope about seventy-five feet long, having an aperture of eight inches. Into this telescope the sun's rays will be reflected by a mirror moving at such a rate that it will reflect rays in a constant direction. This telescope, with one exception, will have greater photographic efficiency than any telescope that has hitherto been used to photograph the sun during a total solar eclipse, and is designed to secure photographs of the corona on a very large scale.

FIELD COLUMBIAN MUSEUM, Chicago, has arranged a course of nine lectures upon science and travel, on Saturday afternoons in March and April, at three o'clock, as follows:

March 4.—'The Explanation of Indian Ceremonies,' Dr. G. A. Dorsey, curator, department of anthropology, Field Columbian Museum.

March 11.—'Giant Reptiles of North America,' Mr. E. S. Riggs, assistant curator, division of paleontology, Field Columbian Museum.

March 18.—'Extinct Mammals of North America,' Mr. E. S. Riggs, assistant curator, division of paleontology, Field Columbian Museum.

March 25.—'Aims and Methods of Bird Study,' Dr. N. Dearborn, assistant curator, department of ornithology, Field Columbian Museum.

April 1.—'Hawaiian Cruise of the *Albatross*,' Professor C. C. Nutting, professor of zoology, University of Iowa.

April 8.—'The Fertilization of Flowers by Insects,' Dr. F. H. Snow, professor of systematic entomology, University of Kansas.

April 15.—'Geographic Factors Involved in the Rise of Chicago,' Dr. J. Paul Goode, assistant professor of geography, University of Chicago.

April 22.—'How Rivers and Lakes became Stocked with Fishes,' Dr. S. E. Meek, assistant curator, department of zoology, Field Columbian Museum.

April 29.—'The Basketry of California,' Dr. J. W. Hudson, assistant in the department of anthropology, Field Columbian Museum.

UNIVERSITY AND EDUCATIONAL NEWS.

By the death of Mrs. George L. Littlefield, widow of George L. Littlefield, of Pawtucket, R. I., Brown University becomes the recipient of the bulk of the Littlefield estate, estimated at $500,000. The will provides that the corporation shall apply the money as it sees fit, except that $100,000 shall be used for the establishment of the George L. Littlefield professorship of American history.

By the will of William F. Milton, of New York, his estate will go to Harvard University on the death of Mrs. Milton. The daily papers state that it is worth between one and two million dollars.

Columbia University has received $100,000 from Mr. Jacob H. Schiff to endow a chair of social work, and the new professorship has been filled by the appointment of Dr. Edward T. Devine, general secretary of the Charity Organization Society, director of the School of Philanthropy and editor of *Charities*. This endowment makes possible the close affiliation between the School of Philanthropy and Columbia University.

The contest of the will of Mrs. Josephine L. Newcomb, who left more than $2,000,000 for the endowment of a college for women in connection with Tulane University, New Orleans, has so far resulted favorably to the interests of the college.

The regents of the University of Nebraska have recently voted $50,000 for the erection of the first wing of a building to accommodate the department of geology and the State Museum. The condition of the department at present is so overcrowded and is so subject to loss by fire that the curator has boxed and removed fifty tons of material during the past school year. This has been lowered for safe keeping in an unused steam tunnel running under the campus. In the hope and full expectation that the legislature of Nebraska will act favorably upon this recommendation of the regents, the Honorable Charles H. Morrill, founder and patron of the Morrill geological expeditions of the University of Nebraska, has offered the department an additional thousand dollars annually with which to pursue geological investigations both within and beyond the limits of the state. This will make it possible for the first time in several years to again resume the annual Morrill geological expeditions which were so fruitful of results from 1891 to 1901.

Williams College will ultimately receive $12,500 by the will of Mrs. Harriet A. Jones, of Chicago.

Mr. E. Whitley has given $5,000 towards the endowment of a chair of pathology at Oxford.

The Cambridge University convocation has voted to retain compulsory Greek in the 'little go' or entrance examination, the vote being 1559 to 1052. It is understood that a majority of the resident teachers preferred to make Greek optional, but the vote of convocation is largely decided by the country clergy who have qualified for the M.A.

Dr. E. O. Lovett, professor of mathematics of Princeton University, has been elected professor of astronomy to succeed Dr. C. A. Young, who has become professor emeritus.

Mr. Harold L. Madison has been appointed instructor in zoology in Brown University.

Dr. C. S. Gager, assistant in the laboratories of the New York Botanical Garden, is acting as instructor in botany at Rutgers College for the last half of the collegiate year.

Mrs. Cornelius Stevenson, president, and several other members of the board of managers of the Free Museum of Science and Art of the University of Pennsylvania have resigned owing to friction connected with criticism of some of the discoveries of Professor Herman V. Hilprecht.

Dr. Charles G. Rockwood, Jr., professor of mathematics at Princeton University, has resigned.

Dr. Spottiswoode Cameron has been appointed professor of public health at Leeds.

Dr. A. R. Cushny, of the University of Michigan, has been appointed professor of pharmacology and materia medica in University College, London.

Professor L. V. Vernon-Harcourt has resigned the chair of civil engineering in University College, London.

SCIENCE

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FRIDAY, MARCH 24, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION H. ANTHROPOLOGY.

SECTION H of the American Association for the Advancement of Science held its regular sessions at the fifty-fourth meeting of the association, which was in progress in Philadelphia, Pa., during convocation week. The American Anthropological Association and the American Folk Lore Society affiliated with Section H.

The officers for the meeting were as follows:

Vice-President—Walter Hough.

Secretary—George H. Pepper.

Member of Council—C. B. Moore.

Sectional Committee—M. H. Saville, vice-president, 1904; George H. Pepper, secretary, 1904; Walter Hough, vice-president, 1905; George H. Pepper, secretary, 1905–'08; F. W. Hodge, W J McGee, Alice C. Fletcher, George Grant MacCurdy, Ales Hrdlicka.

Member of General Committee—B. T. B. Hyde.

Press Secretary—Secretary of Section.

Officers of the American Anthropological Association—President, W. H. Holmes in the absence of W J McGee. Secretary, George Grant MacCurdy.

Officers of the American Folk Lore Society—President, George A. Dorsey in the absence of George Lyman Kittredge. Secretary, W. W. Newell.

The address of the retiring vice-president of Section H, Marshall H. Saville, entitled 'Mexican and Central American Archeology,' was delivered Friday afternoon.

WEDNESDAY, DECEMBER 28.

The afternoon session began with the paper on 'Anthropometric Work at the St. Louis Exposition: (*a*) Sense Tests of Various Races, (*b*) Physical Measurements of Philippine Groups,' by R. S. Woodworth and Frank G. Bruner.

Over a thousand individuals, belonging to twenty-two groups and nine races, were measured, and most of these were subjected also to sensory and mental tests. Among the results may be mentioned: the superiority of some groups, especially the Filipino, in eyesight, and the inferiority of others, the Ainu, Negrito and African pigmy; the presence of red-green blindness among Filipinos to about the same extent as among whites; the general inferiority of other races to the white in fineness of color perception, but no special deficiency in perception of the violet end of the spectrum.

A comparison of the height, cephalic, facial and other indices of several Filipino groups was obtained which showed that, on the whole, the population of the islands is remarkably uniform in physical measurements.

After the presentation of Professor Woodworth's paper, the society adjourned to attend the discussion on 'Mutation Theory of Evolution,' in Dental Hall.

THURSDAY, DECEMBER 29.

The meeting was opened by the vice-president, Walter Hough. The first paper was, 'The Story of a Shield,' by James Mooney.

Professor Mooney said in part:

In the old days all men between twenty-five and fifty years of age, in the Kiowa tribe, had shields. They were the personal property of the mounted warriors and, on the plains, this object was the most prized possession of the Indians. When a warrior was killed his shield was usually buried with him. Each shield had a distinct origin, although a number might be made of the same form and from the same dream. Out of 300 Kiowa shields there might have been 50 shield origins. One man might make many shields, which came from a dream, and the wearers would form a small clan-like body. One of the old shields was that of the buffalo. Its origin was from the buffalo and it had buffalo medicine. It was worn by the medicine men who knew how to cure arrow and gun-shot wounds. As shields were used in warfare, they could be made for no other purpose.

The bird shield was of special interest to the speaker, as he had been more closely associated with it than with any other. A story was related of a Kiowa boy who endeavored to get medicine from a water monster formed like a horned alligator. He approached a pool and looked into the water. He heard the voice of a boy who finally invited him to his father's tent. The young man went in. He saw seven men seated against the wall of the tent. These men turned into birds. Each had a shield which was fastened above his head. They told the young man that they had heard his longings and that they would give him medicine. They would give him a shield. They also gave him nine songs. The shrike gave him the song that was to be sung when he went into battle. The call of each bird was to be used in battle in connection with the proper shield and accompanying the song of the particular bird.

A model of the original bird shield was shown. It had a rainbow, the sunlight and dots representing the ashes thrown down by the old men in the sky. These objects were considered to be great medicine. The inside of the shield contained the secret medicine known only to the owner. This was revealed at the moment that the owner made a charge in battle. Each shield had a number of taboos, the breaking of which was a misfortune; there were, however, many ways of propitiation and thereby overcoming the harm that had been done.

Themistology. EDWARD LINDSAY.

An important branch of the study of man is the science of institutions. Of human institutions one of the most important is law. Law has been defined as any restraint of the individual by the group which is backed by physical force. This overlooks the idea of rules for the adjustment between individuals of the rights inhering in them by reason of their status in the social organization, which are the greater part of law. Different terms for these two concepts are needed; the first may be called *Nomos,* the second *Themis.* The science of themistology would investigate that portion of the law of all peoples embraced within the concept *Themis.* Ethnologists have determined that there are various forms of social organization which have existed at different periods and among widely separated groups, and from the study of these have distinguished successive stages in the evolution of society. In the same way we should examine other themal concepts, as marriage in its various forms, contract, etc., and, after collecting all available facts, study them and determine whether there are ideas recurring generally among different groups which pass through a stated course of development. By this use of the scientific method may be obtained a true science of law. This subject is urged on the attention of anthropologists because the facts must be largely collected among primitive peoples. To distinguish between the two different classes of facts included under the term law, however, is essential to an intelligent collecting of material.

Recent Investigations in the Somatic Anthropology of the Brain of Distinguished Persons, of Individuals of Various Races and of Criminals. EDWARD ANTHONY SPITZKA.

A discussion of the doctrine of cerebral localization, of the significance of brain-weight and of surface morphology in their relations to the intellect and to race, and of the question of brain-heredity. Incidentally the alleged relations of brain structure and crime as maintained by Lombroso and his followers were viewed in the light of recent researches. In the report of the author's studies on the brains of notable men (eleven in all) some interesting results concerning the weight of the brain, the 'concept area,' the cerebro-cerebellar ratio and the redundancy of the callosum were presented in detail.

The Physical Resemblance of Twins. EDWARD L. THORNDIKE.

Measurements were taken of thirty-nine pairs of twins, the results showing that there were always striking resemblances. Various tests were made and tabulated, including physical and mental observations.

The Color Sensibility of the Peripheral Retina. J. W. BAIRD. Read by title.

THURSDAY AFTERNOON, DECEMBER 29.

At the meeting with the American Anthropological Association, Professor W. H. Holmes, vice-president of the affiliating association, presided.

Medical Notes on the Southwestern Indians. ALES HRDLICKA.

The results of five trips to the southwest were presented. These expeditions were made possible through the interest of Dr. F. E. Hyde, B. T. B. Hyde and F. E. Hyde, Jr.

The physical work was reviewed and tables presented showing pulse averages, respiration and temperature. The following tribes were visited and representative individuals measured: The Navajos, Lagunas, Zunis, Hopis, Majaves, Papagos, Pimas, Maricopas, Yumas, Yaquis, Apaches, Tarahumaris, Huicholes, Otomis, Tarascans and Aztecs.

A Tale of the Hudson River Mohican Language. J. Dynley Prince. Read by title.

The Settlement and Transfer of Upper Louisiana. Paul Beckwith. Read by title.

The Use of Study of Anthropology in School. Amos W. Farnham. Read by title.

After the reading of the foregoing titles the meeting was turned over to the American Folk-Lore Society, the paper by Will S. Monroe having been placed on their list.

Dr. George A. Dorsey presided at the meeting.

A 'Report of the Committee on Officers' was read by W. W. Newell. The following officers were elected for 1905:

President—Alice C. Fletcher, Washington, D. C.

First Vice-President—Roland B. Dixon, Harvard University.

Second Vice-President—William A. Neilson, Columbia University.

Councilors—Franz Boas, New York; J. W. Fewkes, Washington; James Mooney, Washington; A. N. Tozzer, Harvard University.

Disenchantment by Decapitation. Address of the retiring president, George Lyman Kittredge. Read by W. W. Newell.

Influence of European Contact on Aboriginal Institutions. Alexander F. Chamberlain. Read by title.

The Kiowa Supernatural. James Mooney.

A very instructive paper concerning the interrelation between the known and the unknown. The making of medicine and its importance to the tribe. One case cited of the Ute Indians killing a Kiowa who was a medicine man. They saw by the painted design on his body that he was a great man. They took his medicine and hoped to profit by it. The Kiowas learned later that the house in which it was kept was struck by lightning. The new owners then disposed of the medicine.

Mr. W. W. Newell called attention to the presence of Miss Mary Speers, a lady who had collected negro songs. He asked that she be allowed to sing some of these southern melodies. In preparing these songs she demonstrated the need of studying the tone of the singer as well as the notes of the song. Four selections were rendered.

Superstitions of School Children. Will S. Monroe.

Mr. Monroe has been collecting the superstitions and games of children for several years. One thousand children were questioned concerning good and bad luck. The predominating good luck charm among the girls was a pin; among the boys, a horseshoe. The number of superstitions among the members of both sexes at different ages were noted and tabulated. These consisted of arrival of company superstitions of which there were twenty-three; those concerning the weather, love and marriage, sickness and death, and the number thirteen. He found that the thirteen superstition does not figure to any extent and was not found in children under ten years of age.

The Tale of Three Wishes. William W. Newell.

A negro story of a man who had three wishes. One should have been for salvation. Other wishes are made and he is given to the devil. When he is being carried away he begs the devil to pick a pear for him. He is so insistent that the devil finally climbs the tree to obtain the fruit. One of the wishes that the man had made was to the effect that any one caught stealing his fruit would have to stay in the tree; thus he had the devil in his power. A second time he gets the devil into his purse in the form of a ten-cent piece. In thus using his wishes the man succeeded in keeping out of hell.

This tale was compared with other wish-stories in which similar details appear.

Influence of the Sun on the People of the Hopi Pueblos. J. WALTER FEWKES.

The epitome of the history of the Pueblos is shown by their ruins.

The earliest forms were on the plains. The second period brought them to the base of the mesas, the third and last to the level tops of the table lands.

The inclination of the house groups on the mesa tops is in two directions—toward the highest point, to obtain the greatest security possible, and on exposures where the maximum sunlight may be obtained. The houses ofttimes form two lines, the direction being northeast and southwest. This peculiarity was first noted by Cosmos Mindeleff. The reason for this uniformity was not estheticism but the position of the sun. This occurs in all of the Hopi Pueblos but two. There are three specific causes for this: (1) the growth of the family, (2) the growth of the house group, (3) the position of the sun.

Among the Pueblos there are only two places where additions to the paternal home can be made, that is on the northeast and southwest of the nucleus or home group. The reason for this is that the additions must not cut off the sun from the house already built. These additions to the home continue as daughters are born and marry.

When a new clan comes to a pueblo it is given a new position which will not conflict with the sun supply of the first group. The growth of these clan houses is a cellular one in which the family is the initial cell. This explains the form of most of the modern pueblos. Some of these are rectangular, which is the form of many of the old ones. This may be explained by the fact that a number of clans participated in the work of building—both in planning and in carrying out the details of construction, in which case the form of the town was probably prearranged. Even in this form of pueblo the terraces and door entrances were usually toward the sun.

The clans have been a great factor in the formation of the house groups. They are responsible for whatever peculiar features may be in evidence in both the ancient and the modern pueblos. The clan problem is a most interesting one. Its solution can be accomplished in no way save by a thorough study of the migrations of each, and its relationship to the pueblo. It is one of the most interesting phases of anthro-geography or psycho-geography in the southwest.

The Work of the University of California. ALFRED L. KROEBER.

A general résumé of the anthropological work done by the university was given. Results of former expeditions were pointed out and the present policy of the department outlined. Work is being carried on in Peru by Dr. Uhle; in California, especially among the Hupa, by Dr. Goddard, and linguistic and general ethnological work in the same state by Dr. Kroeber. These investigations are under the direction of the departmental head, Professor F. W. Putnam.

FRIDAY, DECEMBER 30.

Historic and Prehistoric Ruins of the Southwest. EDGAR L. HEWETT.

Professor Hewett has devoted several years to the study of the remains of the old sedentary tribes of the southwest. He has mapped large groups and presented data to the department of the interior in an endeavor to have certain areas containing ruins set aside as national parks.

His latest work has been the preparation of changes in and amendments to the bills that have been drawn up for the protection of remains on the public domain. This work enabled Professor Hewett to handle the subject in a very comprehensible way.

The groups of ruins were described, the labor expended in each, and what should be done in the way of preserving them for future scientific work. The various bills for the preservation of ruins were explained, and the objectionable features of each pointed out. Reports of the commissioner of the general land office, and a monograph by the speaker were given to members of the section in order that a better comprehension of existing conditions might be obtained.

The Election at Jemez Pueblo. Albert B. Reagan. Read by title.

Prehistoric Surgery: A Neolithic Survival. George Grant MacCurdy.

This paper dealt with a certain type of neolithic surgery having certain points in common with trepanning, and which has been brought to light during the past decade. The type occurs in France over a limited area lying to the north of Paris between the Seine and the Oise. The cicatrice is usually in the shape of a T, the antero-posterior branch following the line of the sagittal suture; and the transverse branch, encountered in the region of the obelion, descending on either side to a point back of the parietal protuberances. In addition to the T-shaped lesion, one skull was marked by two oval perforations, one quite large, and two pits large enough to lodge the tip of the finger. The eight or nine specimens already described are all from prehistoric sepultures known as dolmens. In the opinion of Professor Manouvrier the lesions were produced by cauterization, an opinion which was recently confirmed by the discovery of quotations from ancient texts describing the treatment for melancholia, hypochondria, epilepsy, etc., as prescribed by the surgeons of the Dark Ages. The paper will appear in the *American Anthropologist.*

FRIDAY AFTERNOON, DECEMBER 30.

Mexican and Central American Archeology. Address of Vice-President Saville.

The Bat-eared God of the Zapotecs. H. N. Wardle.

The paper presented a résumé of the knowledge of this god from the pottery urns that have been found and from representations in the old codices.

Officers of Section H for the ensuing year:

Vice-President—George Grant MacCurdy.
Secretary—George H. Pepper.

George H. Pepper,
Secretary.

American Museum of Natural History.

SECTION I, SOCIAL AND ECONOMIC SCIENCE.

Section I is in some respects ideally constituted. It has a smaller body of experts in its membership who plan its programs and work out its policy. The larger number of members represent business experience and practical social effort. It thus combines in its programs the scientific discussion and methods of the expert with the results of well-considered experience in social and economic affairs. This year's program was well supplied with papers representing both phases of interest.

Two joint sessions were held, one with Section D for hearing a paper by Professor A. E. Outerbridge, Jr., on 'Specialization in Manufactures,' and one with the Society for the Promotion of Agricultural Science, to hear the memorial by Professor W. R. Lazenby on the life of the late Major H. E.

Alvord, of the U. S. Department of Agriculture.

The record of attendance of speakers on the published program was one of the best in the history of the section. Out of the twenty-three papers twenty were read in person by the authors. The attendance on the part of the public varied from thirty-five at the first session to seventy-five at the last session. Five different sessions were held, including one afternoon session devoted to the address of the retiring vice-president, Professor Simeon E. Baldwin, New Haven, Conn., on 'The Modern Droit D'Aubaine,' treating of the recent multiplication of succession tax laws, and their application to non-residents, resulting in double taxation.

The following officers were elected:

Vice-President and Chairman.—Professor Irving Fisher, Yale University.

Council—Marcus Benjamin.

Sectional Committee—E. L. Corthell.

General Committee—Henry Farquhar.

The papers presented included the following as reported in abstract:

SESSION ON ECONOMIC QUESTIONS.

The Basis of Economics as an Exact Science. Professor SIMON NEWCOMB, Washington, D. C.

One of the first things to strike us in the effort to apply scientific methods to economics is the absence of nomenclature. We notice, in the first place, that there is no name for the organized system of economic phenomena. Herbert Spencer has used the term 'social organism,' but the objection to that is that it includes more than is necessary. It embraces all phenomena which are social, but there are social phenomena which do not strictly belong to the economic order or which relate so indirectly to it as to be negligible factors in the consideration of economic questions.

Another phase of defective definition may be mentioned. I refer to the fact that there is no name for that portion of wealth which is not capital. Marshall makes use of the inconvenient term of 'wealth of the first order.'

Referring to the economic order as a whole, we notice, to begin with, that it is a unified system, in which the parts are related as means and ends. In economics these terms, means and ends, take the place of the correlated terms cause and effect in the physical order. That is, the relation of means and ends in economics corresponds to the relation of cause and effect in physics. In the economic order capital is means. The problem, then, is to find the relation of capital means to economic ends. We must study from ends to means and from means to ends according as the one or the other inquiry may be necessary to establish the causal relation which is the business of science to ascertain.

Now, as to the method of inquiry. In this procedure we have to distinguish between machinery which is necessary for production and auxiliary means to an end. The machinery necessary for production is, of course, capital in its essential character. The auxiliary means to ends which capital serves to reach is money. But money, important as it is in its auxiliary function, adds nothing to the power of the machine.

Knowledge or direction is needed as another auxiliary in the organization of the means to ends of production.

Socialism overlooks the necessity for the means of production, and seems to be based on the omission of this mediating factor between man's wants and his ends. The socialist is like the man who walks to the edge of a precipice and proposes to proceed even at the risk of losing his life rather than to build a bridge to pass from one precipice to another.

How far can economics be made an exact science? It is often said that this subject depends too much on the vagaries of human nature to bring the economic processes within the category of exactness, This is true to some extent. We all know that the corn and the cotton crops, for instance, are uncertain quantities. We know that these affect economic activities to such an extent as to require constant readjustment. On the other hand, it is true that we know just about how a shortage in the corn crop or a marked enlargement in the cotton crop is going to affect the actions of persons interested. We know how the economic order in general, and how the divisions of enterprises directly affected are going to behave, other things being equal, under the changed conditions in the crop yield. It may, therefore, be said that there is a far greater degree of exactness attainable in measuring the force of economic processess than is usually assumed in the criticism based upon the assumptions of the vagaries of human nature.

We may, therefore, be exact in the investigation of the action of causes. For example, we can study with a remarkable degree of accuracy the influence of the increase of currency upon prices.

We may also make the comparative condition of the masses in different countries a subject of exact study. Take the five different nationalities of Russia, Austria, France, England and the United States. These are given in the order of the wage income, let us assume. The cost of subsistence is about the same in all of them, but wages are lower in the order given. Why is this the case? There must be some exact causes, and the problem is to determine what these laws are.

Another phase of the subject of method on the action of causes appears in the application of mathematical methods or principles to the study of economics. Jevons, for instance, applied mathematical methods to the determination of the law of marginal utility thirty or more years ago, and the principle has been extensively used and developed in numerous treatises since then. The law of supply and demand has likewise been treated mathematically by Marshall.

Returning again to the study of the condition of the masses, the main question is to find the causes of inequality of income. Methods hitherto pursued have generally lacked comprehensiveness. We may, however, assume that these inequalities are determined by the law of supply and demand and by a law of distribution growing out of the law of supply and demand.

One of the first things we notice is the great difference in apparently similar men. The captain of an Atlantic liner, for instance, who has millions of dollars of value intrusted to his care, together with thousands of lives, may in all outward respects and in mental qualities be apparently the equal of one whose judgment and practical capacity could in no wise be intrusted with so responsible a task as that of bringing a vessel across the Atlantic in safety.

The first problem which we may propose for ourselves in this field is that of the effect of supply and demand on the distribution of income. In books three and four of my 'Principles of Political Economy,' published twenty years ago, I sought to work out this problem in its twofold aspects: (1) From the standpoint of the productive process, and (2) from the standpoint of the societary circulation or the monetary movement. The chief difficulty in the solution of this problem lies in the numerous complications of the economic order as represented in changes and the multifarious causes at work. The problem may be simplified in statement by being represented in graphical form. We may, for instance, take the loaf of bread as a product and follow it back through the chain of incipient factors, beginning with the farm on which the wheat is produced as the first step; second, Chicago as a wheat market; third, the baker; fourth, the house of the consumer. The productive process may be said to terminate, temporarily, at any rate, in the house, extending from the farm of the producer to the house of the consumer. On the contrary, the societary process, or the monetary flow, extends from the house of the consumer back through the baker and through the wheat market to the farm where production began. These two currents represent an exact quantity, in the one case of goods, and in the other case of money. They move in opposing directions, and in this respect are analogous to the two opposing currents acting simultaneously, as represented in electrical theory.

There are various other causal factors to be brought into the study of this relation, including such factors as the mechanic, who purchases from the hardware store, the hardware store purchasing from the tool factory, the tool shop purchasing from the rolling mill, and the rolling mill from the mine; but along each of those connections the two currents, productive and circulatory, are in active operation, and all of these factors are directly or indirectly connected with another factor—the government.

This representation may seem at first glance to be complicated by reason of the numerous currents represented in the twofold process, the productive and the circulatory. Could the conclusions arrived at in this method be put in such a form as to have the community accept them? Economic conclusions are not easily accepted by the community in general. Why is this so? One reason—possibly the main reason—is that economists have failed to distinguish between means and ends. To the economist ends, rather than means, are important all the time. The economist, as a rule, has laid so much emphasis on means as to diffuse the sum total of impression made upon the mind of the community. Nevertheless, the individual member of the community and the community as a whole are interested in results, in ends, in income rather than in outlay, but the income in which they are interested is not the monetary income, but real income. I may illustrate this by supposing that in case of our civil war, the policy of the northern states toward the south had allowed exports to be made unhindered, but had prohibited all imports except gold and silver. What would the effect have been? The great majority of people would at first hand say that it would have enabled the confederate states to command the control of all utilities they desired, and thus worked exactly contrary to the blockading policy. But would that have been the case? We see that it would not, as soon as we realize that gold and silver are means and not ends. If the prohibition of imports of economic goods, except gold and silver, had been carried out, the productive process would have been interrupted and the starving-out policy have gone on substantially as it did under the blockade. This illustrates the relative importance of the productive process as distinguished from the monetary movement.

Workings of the Anthracite Coal Strike Agreement. Wm. H. Taylor, St. Clair Coal Company, Scranton, Pa.

This strike was inaugurated May 12, 1902. Five months later President Roosevelt appointed the commission "to inquire into, consider and pass upon the questions in controversy in connection with the strike in the anthracite region, and the causes out of which the controversies arose. By the action you recommend, which the parties in interest have in advance consented to abide by, you will endeavor to establish the relations between the employers and the wage workers in the anthracite field, on a just and permanent basis, and, as far as possible, to do away with any causes for the reoccurrences of such difficulties as those which you have been called upon to settle.'' Meanwhile the strikers returned to work. Five months later, March 18, 1903, the commission made its report to the president. The report says: ''The occasion of the strike of 1902 was the demand of the United Mine Workers of America for an increase in wages, a decrease in time, and the payment for coal by weight wherever practicable; and where not, then paid by car. The cause lies deeper than the occasion, and is to be found in the desire for the recognition by the operators of the miners' union. The great strike of 1900 which resulted in an advance of ten per cent. in the wages paid to all classes of mine workers, did not leave either miners or operators in a satisfied state of mind, for both agree that since the settlement of 1900 there have been increased sensitiveness and irritation in the mining districts as compared with the previous twenty-five years or more.''

Every coal mining company finds, as to the discipline, that there is generally a decided change for the worse; which, although it is known to exist, and is shown in many ways, is still difficult to define. Formerly employees seemed to be willing to turn their hand to anything that would further the work of the company, but nowadays if a man is asked to do a little outside of his regular line, he refuses to do it or does it grudgingly, telling the foreman that it is not his job.

The feeling of sensitiveness and irritation to which the commission referred, has not lessened, but, on the contrary, is a smouldering fire, which breaks forth at the least provocation. The effect of this unfavorable attitude on operations is reflected in the following typical results showing decreased efficiency generally.

One company reporting on all its collieries writes: ''We find that the labor cost of producing coal during the period from November 1, 1903, to April 30, 1904, was 36.9 per cent. greater than during the same months in 1899 and 1900.''

Two other collieries in the Lackawanna region furnish the following statement, showing decreasing efficiency:

TABLE OF COMPARATIVE EARNINGS AND OUTPUT.

Average Items.	Colliery No. 1.		Colliery No. 2.	
	1901.	1904.	1901.	1904.
No. of miners	150	193	170	210
Net earnings per miner, eleven months	$838.64	$871.34	$597.13	$673.14
Net earnings per miner, one month	76.24	79.21	54.28	61.19
Daily wages	4.17	4.34	2.88	3.38
Tons mined per miner per day	9.44	7.46	7.29	6.22

In colliery No. 1, the earnings of 1901 taken as a basis, plus the 14.5 per cent. awarded by commission, should be $959.24; earnings per month, $87.50; per day, $4.77, showing a decrease in net efficiency, notwithstanding shorter hours and advanced wages, of 26½ per cent.

In colliery No. 2, earnings of 1901, plus 14.5 per cent., should give $683.71 as net earnings; earnings per month, $62.15; earnings per day, $3.30, showing net decrease of 16.9 per cent. in efficiency.

The Present Status of Railroading in China. Chung Hui Wang, Yale University Law School.

The present method of railroading in China constitutes one of the prime factors in the shaping of the future destiny of that country. While other countries are now lined with networks of railways, we find that in China the 'iron road' has not yet become a household word. Foreign observers who have but a superficial view of the subject do not hesitate to attribute the cause of this to the superstition, ignorance, prejudice, and what not, of the Chinese people. In my opinion there are two fundamental causes back of this, the one financial and the other political. If we bear in mind that the construction of every mile of railroad costs upwards of $10,000, we can well imagine the financial difficulties with which we are confronted in the construction of a complete system of railroads. Moreover, the heavy indemnities and exactions which have been wrung from us by the foreign powers at different periods since the Opium War of 1841 up to the Boxer uprising of 1900 have almost exhausted our resources, and have consequently increased the difficulties of our problem. Again, railroading is more than a mere economic undertaking; it has political as well as strategic importance. The main objection which has been urged by the high officials against the adoption of railroads is that as long as China is not strong enough to defend herself against foreign aggressions, the presence of railways would be a constant menace to the safety of the country. If we read the Chinese state papers on the subject, we shall notice that the problem has been somewhat overestimated in its political and strategic importance, and underestimated in its economic and commercial aspects.

To Li Hung Chang is usually given the credit for the construction of the first permanent railway in China in connection with the Kiping coal mines, eighty-four miles northeast of Tientsin; but the credit is justly due to a subordinate official, Mr. Tong King Shing, the pioneer of the introduction of modern improvements into China.

After the Chino-Japanese War of 1896, the idea of constructing railroads exclusively with Chinese capital was abandoned as being impracticable, and in March of that year an Imperial Edict was issued encouraging the construction of railroads, and in October, an official of high rank, Sheng Sun Hawai, was appointed Director-General of Railroads with full power to raise foreign loans. This was the beginning of the period of 'concessions.'

Within the past few years 'railroad concessions' covering about 5,000 miles of railway lines have been granted to different syndicates, the largest of which is the Belgian. These 'concessions' provide that the ownership in the railways ultimately reverts to the Chinese government. Concessions are really contracts between the native company of Chinese railways and the foreign syndicates.

Can the South Manufacture Her Own Cotton? Charles Lee Raper, University of North Carolina.

Slavery was a decided hindrance to the highest industrial development, just as the free negro and the free negro's ghost in politics are obstacles to present industrial progress.

The new south is not largely a product of outside energy and capital, but is a revival and continuation of the old life; she is a product of the ability of the southern white man working under new conditions. Though the new south is still far behind the north in wealth and industrial activity, the first twenty years of her life saw more remarkable progress than any other section of this extensive country.

General statistics are not all the evidence that goes to the support of the conviction that this section can become the world center of the manufacture of cotton goods. There is much in the general situation to which statistics can not give adequate expression. Climate, lack of damaging frost, great water power and its freedom from ice, and the cheapness of housing, clothing and feeding the operatives, are all in favor of this view. The specific facts of cotton manufacture during the last twenty-four years show that in 1880 the southern states had less than 700,000 cotton spindles and about $20,000,000 invested in cotton factories. To-day they have about 8,000,000 spindles, or more than eleven times as many as in 1880. To-day they have almost $200,-000,000 invested in factories, or ten times as much as they had twenty-four years ago.

The greatest need of the present is the direct sale of the products of the cotton mill to consuming markets. This is gradually being supplied, and with it the complete chain of economic production—the farmer, the manufacturer, the carrier and the merchant—will be primarily in control of the section of the country which is the source of the raw material.

SESSION ON EDUCATION AND SOCIAL SCIENCE.

Ameliorative, Preventive and Constructive Social Work: and the Ideal Training for Social Workers. Mrs. Anna Garlin Spencer, New York School of Philanthropy.

Social service and social work mean, first, a synthesis of that which is connated in the four basic institutions of society, the home, the school, the church and the state. Social service has in it something of the religious appeal to grow better and stronger, however difficult the growth may be. It has much of charity's special quality of devotion to those whose personal or social condition makes it most hard for them to live a truly human life. It has something of that dependence upon the organized whole of society which has given the modern state its functions of charity, education and public enlightenment through free public benefits. It has much of that spirit of moral reform which is forever blazing out in holy passion of rebuke against tyranny of the weak by the strong. It has, most of all, a giant share of that new impulse in education which demands for each child 'the best development society can afford.'

The supreme distinction of modern social service lies in its fundamental ideals and the conscious purpose in its application of those ideals. Those fundamentals are:

1. A belief in what Horace Mann called the 'infinite improvability of mankind,' a deep faith in the essential good quality of human nature, a faith shared with all new types of religious belief and the root of the new education.

2. A belief that the race is not improved solely or chiefly through its moral and intellectual elite (those capable of becoming saints and sages and leaders), but that the race is to be improved most completely and surely by the upraise of the whole mass of mankind. This is a faith in the spiritual essence of democracy.

3. A belief that here and now society has both the duty and the power to undertake consciously, determinedly, systematically and hopefully this upraise of the whole people, this demonstration in terms of absolute democracy of the worth of all human beings.

4. The belief that in order thus to grow nobler, purer and stronger and happier human beings in this wholesale fashion, society must also work to make a better world for the less fortunate and the weaker human beings now living.

5. The belief that since all the people, especially 'the least of these,' are to be lifted, society must hold itself responsible for the welfare, the safety, the chance to grow, the opportunity for education and the ability to become self-supporting, of every human being.

This then which we call social service is a synthetic appreciation and use of the new ideals of education, democracy and religion.

This synthetic function divides itself into three main departments of social effort, namely: (1) Ameliorative work, (2) preventive work, (3) constructive work.

In all great social activities the three departments named work together and, therefore, the efficient organization of all charitable and reformatory forces is now indispensable to social advance. The modern warfare against disease is a perfect illustration of the interaction of ameliorative, preventive and constructive social work. At least one third of all the persons who require relief of a charitable nature do so because of illness or physical disability.

Child Labor in Southern Mills. A. J. McKelway, Assistant Secretary of the National Child Labor Committee.

The southern cotton mill industry is centered in the Piedmont section of the four cotton states that have mountains, namely, North Carolina, South Carolina, Georgia and Alabama. These are the manufacturing states of the south.

This industry grew up in a night, and old historic communities, holding fast to their *laissez faire* doctrine, found themselves suddenly confronted with the problems for which they had no social experience and no legislative precedents. All of our industries are infant industries. In 1880 there were 667,000 spindles in the southern states. In 1900 there were 7,000,000. In 1900 there were 412 cotton manufacturing establishments. In January, 1904, there were 900, so that this statement of their number is antiquated as soon as it is made. The number has been more than doubled in the last four years. South Carolina stands next to Massachusetts in the number of spindles, and North Carolina is ahead of either in the number of cotton mills, the mills being smaller on the average than those of the other two states mentioned. Considering the shortness of the period of this revival of manufacturing, the south as a whole has acted with commendable promptness in recognizing and seeking to remedy the evils of child labor. The conditions of this industry in the southern states to-day are superior to those in either England or New England and probably superior to those that obtained when the industry was at its best in New England and the operatives were the hardy children of the New England soil. Despite the stories that have been published in the magazines at so much per column, it is a source of gratification to know that people are buying good clothes and good furniture and pictures and books and stoves. The homes of the people are three- and four-roomed cottages, an infinite distance from the one-roomed hut, and every cottage has an acre plat of ground, for the garden, while the pigs and the chickens and the cow have quarters of their own. And there is all of God's out-of-doors for breathing space. There is no night work at the mill, spinning and weaving departments being evenly balanced so that what is spun one day is woven the next. The hours are long, however, from 6 in the morning to 6:30 at night, with an intermission of forty minutes for dinner and a half holiday on Saturday. And this brings up the fact that there are too many young children in that force of a thousand workers and that eleven hours and fifty minutes a day is too long for any child to work in a mill, be the work ever so light.

Work of the National Child Labor Committee. Samuel McCune Lindsay, Secretary, New York City.

The permanent organization of the committee took place at the house of Robert W. de Forest, New York City, November 28, 1904, with a membership of forty-six persons, constituting, perhaps, as remarkable a group of varied industrial, financial, educational and social interests as was ever brought together in America or in any other country. Its membership now represents fourteen states and the District of Columbia. The object is to secure as nearly as practicable uniform legislation and uniform enforcement of laws on this subject throughout the union.

The work before the national committee comprises the education of public opinion, on the one hand, and the bringing to the attention of both the legislative and executive branches of the state and national governments the results of the careful and scientific study of both existing conditions and remedial measures. The national committee hopes to bring together the results of a larger parental responsibility, the better development of the public school system and the enactment of child labor legislation in the several states and territories, and to coordinate these efforts so that the evils of child labor may be eradicated from the industrial system of America.

The Press as an Educator. Wm. H. Lynch, Salem Public School, Salem, Mo.

Jules Verne, the world-famous novelist, wisely predicted that long before the middle of the century novels or romances, in volume form, would be supplanted by newspapers. The newspaper of to-day, great as it is, has yet before it a development and potentiality for usefulness scarcely imagined by its most far-seeing and progressive directors.

It must be obvious to all thoughtful persons that the newspaper may easily be made the medium of imparting valuable instruction in many departments of knowledge on which the very latest text-books are mere blanks. Take, for example, the experiments of Marconi in wireless telegraphy, so minutely recorded and illustrated in almost every newspaper. Would not the study of the despatches, describing the achievements of the great Italian, by boys and girls sufficiently advanced to understand them, be infinitely more profitable than the dull book pages they are compelled to read concerning the laying of the first ocean cables so many years ago? To this question there can be only one answer.

Take another current subject, with the discussion of which the newspapers have been filled in the most instructive and luminous way—that of Venezuela. What might not a competent teacher, with the aid of the press, have accomplished in the treatment of this question toward instilling in the minds of his pupils correct understanding and conception of the Monroe Doctrine, let us say, or a knowledge of the Spanish-American republics generally and our relations to them? Then there was a great coal strike and the war between Russia and Japan.

In the school books are a few meager facts and dates, forgotten almost as soon as they are learned, with respect to that basic factor in the industrial world. With the universal interest centered in the subject and the assistance of the newspaper, the skillful teacher could have done more to expand and inform the minds of all those intrusted to his care than all the text-book writers combined. Children should not, of course, be permitted to read everything printed, even in the newspapers. The latest advances in scientific knowledge, the newest inventions and discoveries, in every branch of human endeavor, are all heralded in the morning or evening despatches. Years hence the text-books will, as it were, embalm them in their solemn pages. Why should the child be compelled to sit in darkness with the light of knowledge blazing all around him?

Ethnic Factors in Education. Dr. EDGAR L. HEWITT, Washington, D. C. To be published in the *American Anthropologist.*

The American Negro. EDWARD L. BLACKSHEAR, Prairie View, Texas.

I. *Some Survivals of Primitive Racial Instincts in the American Negroes.*—The absence or, rather, scarcity of islands and peninsulas and bays and seas along most of the coast line of continental Africa has exerted indirectly a profound influence on African character. As a result, the African tribes have been isolated from all the great historical world movements, and have remained stationary in their social and tribal relations. Deprived of the stimulus of commercial and maritime influences, they have for centuries lain dormant in respect to the higher or organic life of the human species.

Herein lies the secret of the southern racial problem. The real crux of this difficulty is not the mere color of the skin, as is sometimes asserted. It is the sum total of characteristics, mental and moral, of which the exaggerated physique is the material expression and vehicle—it is this that constitutes a race problem when a group of Afro-Americans comes into any sort of relationship for a continued period with an Anglo-Saxon group.

II. *Negroism.*—By this term is meant to be conveyed an idea of a sum total of the characteristics—the mere color of the skin, while the most obvious, being really, as it is literally, superficial—which is the result of centuries of a heredity dominated by a fixity and sameness of environment as barren of differentiating and developing features as the Saharan Desert—a heredity wherein the mere struggle for animal existence and reproduction was the moving force, a heredity whose sameness of environment and want of contact, either friendly or hostile, with different human types, resulted in an exaggeration of qualities, physical, mental and moral. Add to the influences of this unvarying African environment and heredity all the influences of American chattel slavery which served to still further exaggerate tendencies already abnormally developed, and the resultant is what is here designated negroism. The significance of negroism lies in the defective attempt, grotesque to the cultured Anglo-Saxon mind, of the African mind to incorporate into its own thought and being, the real living thought and motives of the Anglo-Saxon race. And herein too lies the gist of the negro question.

The remedy for negroism is the development of Americanism, that is, of intelligent self-respect and a manly regard for others; of self-reliance as manifested in industry and economy and self-support; of a simple, pure, healthy, happy home life as opposed to polygamous indiscriminateness; a regard for peace and good government and good order rather than a scramble for place and power and spoils; a love of country, of home and a love of God manifested in a life of simple sincere piety rather than in manifestations of religious emotionalism unaccompanied or uninspired by the spirit of a genuine Christianity.

On the Desirability of Founding an Institute for the Study of Blood Poisoning. P. A. MAIGNON, Philadelphia.

In these days of immense activity great problems can be settled only by specialization. The prevention of disease is one of these problems. Medical science deals with the cure of disease; sanitary science with its prevention.

Medical and surgical science has been much endowed, but sanitary science has somewhat lagged. Sanitary plumbing and sanitary engineering are about all we hear of in connection with sanitary science.

The writer has for the last thirty years been associated with the sanitarians of London, the hygienists of Paris and in a general way with physicians taking particular interest in the prevention of disease, and it has occurred to him that a good purpose would be served if an institute were founded in this country for the special study of blood poisoning, particularly as regards the first step of infection. The physiological, chemical and physical composition of normal blood is pretty well known, but the immediate phenomena which obtain before the appearance of morbid symptoms do not seem to have been studied to any very considerable degree.

The main object of such an institute for the study of the different phases of blood poisoning, their cycle and variety, should be to find out and indicate the means to prevent the infection in each case.

Sociological Features of the National Irrigation Movement. Guy Elliott Mitchell, Secretary of the National Irrigation Association, Washington.

No question before the public to-day presents more interesting sociological phases than does the national irrigation question in America, not only through the great number of homes to be created by artificially watering desert wastes but through the far-reaching effect of the working out of a great government irrigation policy and the general education of the American people on the advantages of this practise both west and east.

The social side of irrigation can be described in the single clause—irrigation subdivides and resubdivides lands into small home tracts.

Irrigated communities average the smallest farms in the world. The most highly developed portion of the west contains thousands of five and ten-acre farms from which men are making comfortable livings. The social conditions of some of the most intensely irrigated tracts are perhaps the most nearly perfect of those of any communities in the world.

Now the effect of the great government irrigation work, which is being pushed rapidly forward, will be to create a western empire of new homes and at the same time, incidentally, thoroughly to educate the people of the entire country on the subject of irrigation. The consequence will be that irrigation practises will finally enthrall the eastern farmer. The facts as they exist in European countries show that irrigation can be practised with great profit even on land which has sufficient rainfall to grow paying crops. Irrigation is a crop insurer, besides producing double yields, and when it is applied to eastern farm lands the same conditions will result which are found in the arid region—the farms will be divided into smaller and better tilled tracts.

Along with the prosecution of the government irrigation policy and its great agricultural educational features will come the establishment of rural colonies throughout the entire country, home-acres for factory employees, making them to an extent independent of their daily wage, and the gradual trend of the city congestion back to the land as the primal source of all wealth. Working along with this policy of intensive farming and high cultivation is a recognized movement to engraft a practical agricultural education, nature study and handicraft work, upon our common school system so that men and women of coming generations will both want and strive to own a home on a piece of land and when they secure it will know how to make it productive and attractive.

STATISTICAL SESSION.

Beef Prices. Fred C. Croxton, U. S. Bureau of Labor.

An advance in fresh beef affects the expenditure of the working-man's family as much as would the same advance in the price of each of the four items, flour, corn meal, bread and milk. An advance in beef of two cents per pound means (if he buys the same grade and quantity), the expenditure of an additional amount equal to the cost of lighting, or to taxes and property insurance combined, or to the expenditure for books and newspapers.

The retail price of fresh beef at the present time is about ten per cent. above the average for the ten-year period from 1890 to 1899. The value per pound of the fresh beef exported also shows a decided advance. The average value for the last five years was 11.4 per cent. above the value for the preceding five years, and 13.3 per cent. above the value for the five years ending June 30, 1894.

A study of prices during the last fifteen years shows that with few exceptions the prices of beef cattle, of fresh beef at wholesale and of fresh beef at retail advance and decline together, but not to the same extent. The margin between beef at wholesale and at retail is usually rather close. While some parts of each carcass are retailed at two or three times the cost at wholesale, a considerable portion, if sold at all, must be sold for less than was paid at wholesale. In the early part of the present month, a 'top' carcass which cost the retailer seven cents per pound was sold in Washington as follows: 22 per cent. (including trimmings) at three cents or less per pound; 30 per cent. (including trimmings) at six cents or less per pound.

The demand for fresh beef at home has increased, owing to the increase in population, the greater proportion of persons living in cities and towns, and to improved industrial conditions during the past few years. The demand abroad, as shown by our exports for the five years ending June 30, 1904, was 21.7 per cent. greater than for the preceding five years, and 55.6 per cent. greater than for the five years ending June 30, 1894.

The most difficult question encountered in a study of beef prices is that of the supply. The estimates of the Bureau of Statistics of the Department of Agriculture show an increase from 1890 to 1904 of 15.6 per cent. in the number of cattle in the United States, while in the same time population increased about 30 per cent., and the exports of fresh beef increased 72.9 per cent. Deducting the amount of fresh beef exported from the amount sold by wholesale slaughtering and packing establishments, the number of pounds remaining per capita was 40.5 in 1890, 34.1 in 1900 and is estimated at 40 pounds in 1904. These figures do not of course represent consumption, but afford some measure of the relative amount of fresh beef sold in each year.

One of the most important factors in determining the beef supply is the corn crop. The price of corn makes more abrupt changes than does the price of cattle, yet the course of the prices of the two commodities is almost identical.

Above are considered what may be called the natural conditions in the beef industry. It is possible that combinations of packers exist, which would doubtless exert a steadying influence on declining prices; or a combination might be strong enough to control to some extent the prices of cattle bought for slaughtering, or the supply of beef shipped, which would seriously affect the price to the consumer.

Movement of Wood Prices and their Influence on Forest Management. B. E. Fernow, formerly U. S. Division of Forestry.

Dr. Fernow refuted, by means of statistics presented in the form of diagrams, the position of one of the noted English statisticians, Mulhall, that wood prices had fallen and would continue to fall, because the supply of timber was practically inexhaustible. The data upon which the English authority based this conclusion were shown to be worthless. The speaker pointed out the difficulties of securing useful data, from which to diagnose the past and predict the future of price movements, and explained that, and why, prices for lumber did not really represent prices for wood or stumpage. From careful compilations of the experiences of European forest administrations it was shown that wood prices had for fifty to seventy years increased at a compound rate of not less than 1.5 per cent. and for the last ten years at a rate of over 2 per cent., being now at least double what they were fifty years ago. Such data as were available for the United States showed the same tendency and about the same rate; and as the knowledge of the condition of timber supplies in the world was growing, wood prices would increase at an accelerated rate 'until that level has been reached which forces reduction of consumption.' The influence of the increase of wood prices on forest treatment was discussed at length, as tending to supplant the rough exploitation which alone appeared profitable at present, by forestry, *i. e.*, care for the reproduction of a new wood crop.

The Present Demands and Economic Uses of Wood. Wm. R. Lazenby, Ohio State University, Columbus, Ohio.

This paper will appear in full in the *Proceedings of the Ohio State Forestry Society.*

The Wheat Situation in the United States. John Cassel Williams, Washington Correspondent, New York *Journal of Commerce.*

Since the season of 1901 there has been a falling off in the production of wheat in this country, while the increase in consumption has gone steadily forward until the point has been reached at which, temporarily, at least, domestic consumption is about equal to the domestic supply and only a small surplus is available for exportation. The final figures of the Department of Agriculture for the wheat crop of 1904 issued by Chief Statistician Hyde put the total yield at 552,399,516 bushels, against 637,822,000 bushels in 1903, and 748,400,000 bushels in 1901. Though in some years there have been considerable quantities of wheat carried over from one season to another in the visible supplies and in the stocks estimated as remaining in the hands of farmers, the exports of wheat and wheat flour have, from year to year, afforded an approximate measure of the excess of production in the United States over the domestic demand.

Owing to the falling off in production and to the increase in domestic consumption, exports of wheat from the United States have temporarily, at least, practically ceased and exports of wheat flour have been greatly reduced in volume.

The American miller, endeavoring to retain his foreign market, is hampered, not only by the shortage of the domestic supply of wheat, but, also, by the inferior quality of a large proportion of that grown during the past season. The evidence submitted to the treasury department by millers who have asked for an allowance of drawback on the exportation of flour made wholly or in part from imported wheat shows that, while in former years an average of four bushels and twenty pounds of wheat have been required to make a barrel of flour, the average quantity of domestic wheat required this year is four bushels and fifty pounds. Complaint is made that, even if domestic wheat is used to make flour for export, it is extremely difficult to make the quality necessary to keep up the reputation of the established American brands. Across the northern border in Canada there are ample supplies of wheat of good quality, if the American miller could draw upon that supply of his raw material.

The great body of the millers would welcome the absolute repeal of the duty on foreign wheat and there would doubtless be a vigorous demand for this repeal from other elements in the population of the United States if it were generally understood that, for some months past, the price of wheat in Canada has been from fifteen to twenty cents per bushel lower than in the United States, and that the effect of this has been to increase the cost of flour in the United States by from eighty-five cents to one dollar per barrel, thus increasing the cost of living to every customer of wheat flour in the United States.

What is to be the future relation of the domestic supply of wheat in the United States to the domestic demand? The operation of certain tendencies in American agriculture seem to indicate that wheat production in the United States can not be expected to increase in the future at a much greater rate than will be necessary to supply the increasing domestic demand. It is not impossible that the ultimate result of the operation of these tendencies will be to make the United States a permanent importer of wheat under normal conditions.

SESSION ON PROBLEMS OF COMMERCE, ETC.

Present Status of Maritime Enterprise. Winthrop L. Marvin, Secretary of the United States Merchant Marine Commission, Boston, Mass.

While ocean shipping is in a distressed condition in Europe, it is in a desperate condition here. The Merchant Marine Commission has visited within eight months all of the chief ports of this country and it has not found anywhere so much as one new steamship designed for foreign trade in process of construction. It is, therefore, more than temporary depression which afflicts the ocean shipping of the United States. We are face to face, unless something heroic is speedily done, with the final vanishing of an old, historic industry. It will be generally agreed that President Roosevelt sent his urgent appeal to Congress none too soon. The report and recommendations of the Merchant Marine Commission will be laid before the Senate and House next week.* Though they can not be outlined beforehand, of one fact every member of the Congressional Commission is certain, and that is, that without vigorous national aid and encouragement of some kind we shall inevitably lose the last of our deep sea mercantile marine, not only the ships themselves, but the skilled officers and seamen.

The Merchant Marine Commission in its inquiry has found that all the maritime nations of the world protect and encourage their ocean shipping in some way or other. The most conspicuous instance of this practise is Great Britain's recent grant of $13,000,000 to build two new Cunard steamships, which will receive besides an annual subsidy of $1,100,000 for twenty years. Within sixty years Great Britain has expended about $300,000,000 in subsidies to her steam lines through all quarters of the world; and this, with the vigorous discrimination of Lloyds against foreign shipping, has made impregnable the British mastery of the sea, which was first gained by the navigation laws of Cromwell and the victories of Nelson.

* Senate Document, Report No. 2755, 58th Cong., 3d Sess., 70 pp. To be had upon application to Senator Gallinger.

The Merchant Marine Commission has given some attention to the free ship policy. In reply to inquiries addressed to the chief American owners of foreign-built steamships, these companies one and all declare that they would not bring their foreign ships under the American flag if they were given an opportunity, unless Congress by subsidy, bounty or discriminating duty enabled them to meet the higher wages of American officers and seamen. The Merchant Marine Commission, therefore, has been forced to turn to the alternative of direct national aid and encouragement to our merchant shipping. The exact conclusions which it has reached will be revealed when the report and recommendations are presented to Congress.

Unconsidered Phases of Foreign Trade. Harold Bolce, Washington, D. C. To be published elsewhere.

This paper was presented orally and dealt with the inadequacy of efforts on the part of the United States to secure a more favorable commercial position in the Far East, in South America and elsewhere, where the best efforts of rivals were making it more difficult each year for the United States to obtain a footing.

Analogies Between the Evolution of International and of Private Law. Edward Lindsay, Warren, Pa., Academy of Sciences.

As the ethics of a people are in advance of its laws so are the ethics of the individual always in advance of the ethics of the people as a whole. The individual is always in advance of the crowd, the group or the state. We would, therefore, expect to find the laws governing nations in their intercourse with each other in a less developed state than those governing individuals in their relations with each other. Such is in fact the case. A comparison of international law with the growth and progress of private law will afford information as to the stage and development international law has reached and something of what we may expect from its future growth. This comparison was made between:

1. *Treaties and Contracts.*—Treaties are contracts between nations. In international law in respect to treaties the binding force of the engagement is determined more from the formalities of the declaration of the treaty than from the agreement itself. In an earlier stage of private law this was also true of contracts; origin and history of contracts.

2. *War and Trial by Combat; War the Recognized Means of Settling a Dispute.*—In private law at a certain stage was employed the judicial combat which degenerated into the duel and has now become obsolete.

3. *Arbitration and an Action at Law; Arbitration a Rudimentary Judicial Process.*—In private law we have it to-day as a survival in some instances and there is much reason to think that it was a stage in the evolution of law courts and legal proceedings which was passed through by these institutions. International law may be expected to follow the same course of development in general as private law. International legislation, however, probably is inadvisable. Growth of international law best assured by international court to ascertain and declare the law in concrete cases.

The Meaning of Maritime Expansion. John Franklin Crowell, Washington, D. C.

The upshot of it all is that we as a people are in the tropics. Moreover, we are there in all probability to stay. Ten or fifteen years ago a professor of history sneered at the idea of the annexation of Cuba. But the recent reciprocity treaty put the commercial relations between the two countries on a basis which makes economic annexation inevitable. Furthermore, every leading British possession in the West Indies has for some years been seeking reciprocal trade treaties with the United States, as a means of economic salvation. The fact is that the American tropics find their natural market for raw materials in the United States. We must find enlarged markets in these as yet undeveloped peoples. Step by step both the pressure from within and the course of events from without are drawing us out into relations with transoceanic countries which already make it necessary to look to the maintenance of communication with the different continents by sea.

At last then we are numbered among the great powers which have borne the burden of the world's colonization. We are there primarily because of the inequality in the degree of economic development, comparing tropical communities with our own. The relation of the more highly developed countries of the temperate zone to the comparatively undeveloped peoples of the tropics is one of the greatest of problems arising out of maritime expansion. The experience of most countries has resulted in one form or another of political dependence on the part of the natives; this political dependence with its varied institutions has its basis generally in an economic dependence or rather interdependence. Among these economic relations are invariably lines of communication and commerce by sea between the foreign country and the dependent territories. Great Britain requires control of the Mediterranean by reason of her relations with Egypt, India and Australia. One can not understand the history of modern peoples without taking into account this relation of the white races to the tropical peoples. With all of its dark pages, there are many proofs of the truth that the greed for gain has been subordinated to dictates of humanity, in dealing with these wards of the northern races. The missionary spirit has helped to temper the ferocity of mammon, and sooner or later insisted on the abolition of slavery throughout the entire region of conquest. There has been a moral expansion running parallel with the political and the economic expansion. Development of purchasing power rather than wasteful exploration of the population has come at last to govern tropical policy.

John Franklin Crowell,
Secretary.

THE SAINT PETERSBURG CONFERENCE ON THE EXPLORATION OF THE ATMOSPHERE.

As some readers of Science may remember, the International Meteorological Congress which met at Paris in 1896 appointed a committee to further the exploration of the free air, then already in progress in Europe by means of balloons, and at Blue Hill in this country with kites. The committee bears the somewhat ambiguous name: 'International Committee for Scientific Aeronautics,' and has had for its president Professor Hergesell, director of the meteorological service of Alsace-Lorraine. Originally consisting of eight members, it now numbers about fifty, representing eleven European countries and the United States, for, although our national Weather Bureau has not had a representative on the committee, the writer attended the meetings that were held at Strassburg in 1898, at Paris in 1900 and at Berlin in 1902, and has endeavored to advance the objects of the committee in the United States.

The fourth meeting, appointed for last autumn at St. Petersburg, was regarded as of exceptional importance and, accordingly, the invitations issued by the Imperial Academy of Sciences brought together, from ten countries, seventeen members of the committee besides about sixty other meteorologists and aeronauts, the latter both civil and military. At the head of the local committee of arrangements was General Rykatchef, director of the Central Physical Observatory, and to him the success of the meeting is chiefly due, for, although the war with Japan had reached an acute stage, it was not allowed to alter the scientific and social program. The first session was held in the palace of the Academy of Sciences on August 29 (new style), when the order of business was adopted, and the same afternoon the conference was formally opened by the Grand Duke Constantine Constantinowitch, president of the Academy, who brought the greetings of the Czar. General Rykatchef then explained the arrangements that had been made for the meeting and Professor Hergesell reported on the work that had been accomplished since the committee had met two years before.

The following day the scientific meetings were begun, these being open to members of the conference, and, with the exception of two days devoted to excursions, they continued until September 3. There were sessions both morning and afternoon which were presided over successively by two members of the committee, and the questions considered came under the following heads: Organization of international observations, special investigations, instruments and technical matters, resolutions. As regards the first, it was deemed essential that each country should possess a special organization for the exploration of the atmosphere and that the results should be published regularly. During the past three years the cost of publishing such observations in monthly volumes has amounted to $10,000, and this has been borne entirely by the meteorological service of Alsace-Lorraine. It is now proposed that the various countries participating in the exploration of the atmosphere shall contribute $1,000 or $1,200 annually, receiving in exchange copies of the publication, and this proposition is to be transmitted through diplomatic channels to the countries represented at the conference.

With respect to the international ascensions of kites and balloons which, for several years, have taken place on the first Thursday of each month, it was decided to continue this practise, but, in order to study the successive diurnal changes, there will be, in addition, ascensions on three consecutive days during April and August, 1905, the dates during the latter month including the day of the total solar eclipse, August 30, when an ascent of a manned balloon was promised at Burgos, by the Spanish representative, Colonel Vivez y Vich. It was also decided that the balloons should be despatched in each country at the hour which corresponded to its daily synoptic weather-map. A statement of the number of *ballons-sondes* lost in Europe showed that this did not exceed four per cent. of those liberated. The committee recommended that observations of cloud-drift should be made at the time of each balloon ascension, in order to determine the motion of the upper currents, and in these observations the nomenclature of the clouds ought to correspond exactly with the international classification. For this purpose a new edition of the 'International Cloud Atlas,' which is now out of print, will be issued.

Dr. Assmann, director of the aeronautical observatory of the Prussian Meteorological Institute, described the new observatory to be erected in large grounds, thirty-five miles southeast of Berlin, because at the existing observatory, in the suburbs of that city, the trailing kite-wires constitute a danger to life and property. The new establishment will be in every respect a model one, where balloon and kite ascensions are to be made several times a day, a motor-boat on a lake permitting the kites to be flown even in calm weather, and, in this way, it is expected that practically continuous meteorological records will be obtained in the free air. As an indication of what had already been done in this respect, Dr. Assmann exhibited a chart, encircling the hall, on which were plotted the isotherms at different heights above Berlin, obtained from the ascensions of kites and captive balloons made daily for more than a year. From them Dr. Berson showed that the wind-direction shifted to the right-hand with increasing altitude. To complete an account of the aeronautical establishments in Germany for atmospheric soundings, Professor Köppen described the kite-station of the Deutsche Seewarte, in Hamburg, where kite-flights are made every day that the wind conditions allow, the observations being published the same day, with those obtained simultaneously above Berlin, in the weather-bulletin issued by the Seewarte. Professor Palazzo, director of the Italian Meteorological Office, recounted what was being done in Italy to explore the free air, including the recent use of *ballons-sondes,* and General Rykatchef explained the development of the aeronautical section of the Constantine Observatory at Pawlowsk, which was later visited by the members of the conference. Here kite-flights are made whenever possible, the observations being immediately published in the synoptic weather-report of the Central Physical Observatory. The committee considered that a balloon and kite-station in the southeast of Europe is desirable and expressed the hope that the Roumanian Meteorological Service would cooperate in the international ascensions, and also that a kite-station might be established at Pola, Austria, thereby filling a gap in the distribution of such stations.

Mr. Rotch stated that from the observations obtained with kites at Blue Hill during cyclones and anti-cyclones the former appeared to be the warmer up to a height of at least two miles. *Per contra,* M. Teisserenc de Bort concluded from his observations with *ballons-sondes* in France that the vertical decrease of temperature in cyclones up to six miles was faster than it was in anti-cyclones. This last speaker gave an account of flying kites from a Danish gunboat in the Baltic in 1903, when the record height for kites of more than 19,000 feet was reached, as mentioned in SCIENCE, Vol. XVIII., pages 113–14, and he also described recent experiments on his own steam-yacht in the Mediterranean. The most interesting communication, however, was by the president of the committee and related to the atmospheric soundings with kites that he had just executed on board the steam-yacht of the Prince of Monaco, while cruising in the Mediterranean and in the vicinity of the Canary Islands. It will be remembered that the present writer proposed a more extensive campaign of this nature at the Berlin Aeronautical Congress, and unsuccessfully applied to the Carnegie Institution for a grant of money to equip a steamship to make a series of kite-soundings through the trade-winds and doldrums. Moreover, in 1902 he endeavored to interest the Prince of Monaco in such a scheme, as his colleague, Professor Hergesell, succeeded in doing two years later, and the results of these soundings, which Professor Hergesell announced at St. Petersburg, eminently justified the cooperation. The northeast trade-wind was seen to diminish and become more easterly at the height of a quarter of a mile, then falling calm, and even though the kites were lifted by the motion of the vessel to a height of nearly three miles, the southwest anti-trade, which is supposed to form the return-current, was not encountered, though it has been reported at a much lower altitude upon the Peak of Teneriffe. The temperature was found to decrease up to a third of a mile in height, where there was an inversion of temperature persisting throughout a thick stratum and then a rapid decrease with increasing height, these changes being analogous to those prevailing within areas of high barometric pressure over the land. The interesting investigations of Professor Hergesell furnish additional evidence of the importance and feasibility of carrying out soundings of the atmosphere across the equator and into the southeast trade-winds. The employment of kites to obtain meteorological observations on steamers pursuing their regular courses, the practicability of which the writer demonstrated on a voyage across the Atlantic in 1901 (see SCIENCE, Vol. XIV., pages 896–7), was discussed and it was reported that two German steamship lines and a Spanish company had agreed provisionally to allow observations with kites to be made on their steamers. In view of the importance of studying the meteorological conditions high above the oceans, the committee requested the meteorological bureaus of the various countries to propose to their maritime agencies that kites be employed on the mail and other subsidized vessels, the results of these negotiations to be reported at the next conference.

Recording instruments for balloons and kites were discussed in detail, but it was considered inexpedient, at the present time, to recommend the adoption of any special type of instrument, though the committee requested that a description of the instrument employed should accompany all published observations. The errors of aneroid barometers, caused by residual elasticity and by temperature, were said to be less with the Bourdon tubes than with the usual cylindrical vacuum-boxes and, consequently, the former are to be preferred for *ballons-sondes*. Very light instruments of French and German construction were exhibited, in which the barometer was a Bourdon tube and the thermometer either a bimetallic bar, bent in circular form, or a German-silver tube inclosed in a polished one. Professor Hergesell showed his instrument for manned balloons, where the necessary ventilation of the thermometers is supplied by an exhaust fan, placed in the thermometer-tube just mentioned, and driven by a storage-battery and Dr. Shaw, secretary of the London Meteorological Office, presented Mr. Dines's simple meteorograph for kites that costs but twelve dollars. An apparatus was shown by the writer for determining on a moving steamer the velocities of the true and apparent wind—which latter only is utilized in kite-flying—the speed and course of the vessel enabling the triangle of forces to be solved. Most of the other apparatus which was brought before the conference related to the balloons or their accessories. The closing session of the conference was a ceremonious one at which Count de La Vaulx, of Paris, and Dr. Berson, of Berlin, gave accounts of the longest balloon voyage, from Paris to Kief, and the highest ascension, to 35,000 feet, executed by them respectively.

As is usual at these international gatherings, the social entertainments and visits to scientific establishments were the most interesting features. The first of these was an informal reception at the Grand Hotel before the conference opened, followed the next evening by a sumptuous banquet at the Army and Navy Club, which was attended by the Grand Dukes Constantine and Peter, as well as by many Russian officers and scientific men of high rank. The Imperial Geographical and Technical Societies held a joint session in honor of their foreign guests, which was followed by a supper. After a morning spent at the Pawlowsk Meteorological Observatory, when a *ballon-sonde* and kites were sent up from the aeronautical grounds, the Military Aeronautical Park was visited in the afternoon and here all the apparatus of the balloon corps could be inspected, including that which its commander, Colonel Kowandko, was about to take to the seat of war in Manchuria. Another day was occupied by an excursion into the Gulf of Finland on a small government cruiser. Notwithstanding a gentle wind, the light hemispherical kites of Mr. Kusnetzof were easily raised by the motion of the vessel and proved very stable. A satisfactory demonstration was given of the writer's apparatus to determine the true and apparent wind on board. Salutes were exchanged with the Baltic fleet off Cronstadt, and this was only the second reminder that the country was at war, for no evidence of it was apparent at St. Petersburg. After the close of the conference there was an excursion to the Peterhof palace, and on the following day some of the guests were taken up in military balloons, but, unfortunately, the chief object of the ascension, a comparison of the different types of meteorological instruments, failed on account of unfavorable weather.

From the foregoing it is evident that the proverbial Russian hospitality was limited only by the brief time available. The strongest impression left by this reunion at St. Petersburg is a realization of the earnest and widespread efforts that are being made to investigate the conditions of the high atmosphere, and it may be confidently predicted that still greater progress will have been achieved before the next international conference is convened at Rome in 1906.

A. Lawrence Rotch.
Blue Hill Meteorological Observatory,
February, 1905.

SCIENTIFIC BOOKS.

Food Inspection and Analysis: For the Use of Public Analysts, Health Officers, Sanitary Chemists and Food Economists. By Albert E. Leach, B.S., Analyst of the Massachusetts State Board of Health. New York, John Wiley and Sons; London, Chapman and Hall, Ltd. Cloth, 10″ x 6¾″. Pp. xiv + 787; 278 figs.

The foregoing title very well describes this book written by one of America's analysts of longest experience in this field of chemistry. It is not a manual of food technology or of food physiology, even to such extent as the treatise of König and Dietrich. One chapter is, indeed, entitled, 'Food, Its Functions, Proximate Constituents and Nutritive Value,' but it is given almost entirely to general definitions and classifications for the main groups of food constituents.

Neither is it a text-book of organic analysis. Little space is given to the general principles of determination for fundamental constituents or to those of the construction and use of such apparatus as the polariscope and microscope. Other special treatises, such as volume three of Wiley's 'Principles and Practise of Agricultural Analysis,' Blyth on 'Foods' and Leffmann and Beam's small book on 'Food Analysis,' devote more attention to these general subjects. They have, however, been sufficiently developed to guide the amateur to the essentials of operation and to give most helpful suggestion to the trained analyst, with special referenee to the particular operations involved in this branch of food analysis.

Food inspeetion, its principles and the precautions necessary in its conduct are ably, though briefly, discussed. The care of samples with reference to their identification when introduced as exhibits during a trial, might well have received more detailed consideration. For such as are beginning the work of executive management of a food control or the duty of sampling agent, a tabulated list of the quantities of sample needful for the several kinds of analyses would have had much value.

In discussing the methods of repressing food adulteration the author states that publication has proved a sufficient deterrent, when accompanied by prosecution in a few extreme cases. An expression somewhat contrary to this has recently been published by Director Jenkins, of the Connecticut Agricultural Experiment Station, which is the agency for food inspection in that state. Dr. Jenkins notes that publication, which has heretofore been used as the deterrent from adulteration for most foods, is proving less and less effective, and he urges the need for legislation providing for more stringent measures. The experience of the several states in the matter of fertilizer inspection has shown, on the other hand, that publication is entirely sufficient to repress the fraud once widespread in that trade. The buyer of fertilizers watches closely the inspection reports and avoids dealing with firms that conspicuously fail to meet their guaranties. While it is too early to conclude with reference to the effectiveness of publication as a deterrent from fraud in cattle foods, such inspection having been but recently established, the facts now available indicate that this means is as efficient as in case of fertilizers. It is true that both fertilizer and cattle-food laws contain penal clauses, but these are rarely, if ever, invoked. Is the admitted lack of effectiveness in repressing the adulteration of human foods due to the failure of the publications to reach the buying public—usually the housewives—or are we more indifferent respecting the adulteration of that which we ourselves eat than we are of the food intended for our cattle and our plants?

The chief aim of the book has been to aid the analyst in the detection of food adulterations. For this purpose he must not only know how to detect the presence of foreign substances, but also to interpret departures of the common constituents from their normal proportions. Referring first to the latter requisite: While certain staple foods, such as bread, meat, milk and fruit are used by all civilized countries, the latter differ much in their choice of foods of secondary importance and in their methods of food preparation. America has her own strains of dairy cows, her own varieties of fruit and grain. She buys her imported foods in certain markets rather than in others. Her methods of food manufacture differ at many points from those adopted in other lands. For this reason, the American analyst is unable to rely with full confidence upon the bases of comparison established in German, French or even British experience, and has turned actively to the study of American foods.

Wiley and his assistants began this study years ago, and Leffmann and Beam have ably condensed and supplemented their results in the little manual, 'Food Analysis.' The past decade has witnessed great activity in this field. The Bureau of Chemistry has added much of value to its earlier work; the human nutrition investigations of the Office of Experiment Stations has contributed numerous analyses of American market products; the several agricultural experiment stations have richly increased the literature respecting milk, grains, fruits and other raw materials; and the food inspection laboratories have not confined themselves to the routine examination of food samples, but have studied carefully many of our most important food products. To its general methods of determination for the major groups of food constituents the Association of Official Agricultural Chemists has added provisional methods for the use of food inspection laboratories, and is engaged upon the formidable task of thoroughly testing them prior to their full adoption as 'official methods.' It began, a few years since, the formulation of a series of food standards for the United States. The latter work thus inaugurated, Congress has recognized and placed upon a formally official basis.

The mass of information thus gathered in American laboratories, together with the more recent developments in European food inspection, scattered through numerous books, official publications and scientific periodicals, the author has ably systematized and condensed. Few American contributions of importance seem to have escaped his notice. Nearly two hundred carefully compiled tables of composition are given, and upward of fifty tables showing the physical characters, chemical constants, etc., of food constituents, are introduced. No important class of foods has failed to receive careful consideration. In this respect, this book is better balanced than any other in this field with which the writer is familiar.

As a guide to special analytical methods the work is no less valuable. It is not an indiscriminate collection of proposed methods. Those presented have been carefully chosen, often as the result of use by the author and with notes and modifications proceeding from his experience.

The microscope as an essential instrument in food analysis is discussed with especial reference to such use, and numerous cuts portraying the histological characters of plant tissues are given, together with a fine collection of half-tones from photo-micrographs prepared by the author. The uses of the newly invented immersion refractometer are especially discussed.

Every laboratory should be planned and equipped with reference to the purposes for which it is to be used. The chapter devoted to the construction and outfitting of a food inspection laboratory contains many ingenious and helpful suggestions. The appliances for the utilization of electricity as a source of heat and power are particularly noteworthy. Throughout the book appear numerous clearly drawn cuts of apparatus, to the number of nearly one hundred. With reference to laboratory equipment, a very useful feature of the book is a list of the needed reagents, with directions for their preparation and tables of their chemical equivalents.

The worker in the field of food chemistry will find of great value the list of bibliographic references with which each chapter closes. In these lists appear not only the most important references given in the 'Vereinbarungen zur Untersuchung von Nahrungs- und Genussmitteln' (Berlin, 1897), compiled by a commission of German food chemists at the instance of the German Imperial Bureau of Health, but many other European references; and a very full series relating to American food literature has been added.

In literary style, the book is clear and concise. The publishers have given it an attractive typography and have illustrated it liberally and well.

To prepare so comprehensive a work without fault in detail of statement or in the selection of material would probably be impossible. Some of the criticisms that are suggested by a careful preliminary examination may be given as illustrative: In referring to 'official methods,' they are not always given in full; one of several alternate methods is occasionally described as 'official' without indication of the fact that there are alternative methods of equal official status; modifications of official methods are sometimes presented without the nature of the modification being clearly stated. Such modifications are usually of a minor character, but not always. The analyst desiring to follow the official method in all its details must, therefore, refer to the bulletins in which those methods are officially set forth.

There are a few striking omissions: No description is given, among the general methods of food analysis, of Stutzer's method for the determination of albuminoid nitrogen. No allusion is made to the methods of quantitative microscopy, nor to the use of clystering phenomena as aids to the identification of starches in mixtures. For the computation of pentosans, the older factors are given, instead of Kröber's revised factors, now generally adopted by specialists in the field of carbohydrate chemistry.

While the cuts as a whole are admirable, those for the several cereal grains, after Villiers and Collin, do not at all clearly represent the distinctive differences between the several species as respects the hairs and bran coats, tissues of especial value in distinguishing these grains when mixed. Some of the microphotographs are too poorly defined to be useful.

All considered, however, this book is the best manual on its special subject in the English language, possibly in any language. It is certain to take its place upon the reference shelves of every American food laboratory.

Wm. Frear.

State College, Pa.

Psychology. By James Rowland Angell. New York, Henry Holt and Co. 1904. Pp. vii + 402.

No one, perhaps, is better fitted to unite in a text-book the standard 'general' psychology which James' 'Principles' represents and the results of recent experimental studies, than the author of this book. The addition of comments from the so-called 'functional' point of view will also be welcomed by the majority of qualified teachers of psychology. We feel the gratitude and satisfaction which are due to a thoroughly capable thinker who gives us a solid, careful and, so far as is desirable in a text for students, original book.

There is no need to note in detail the many excellent features in content and form or the few cases of questionable facts and methods of presentation. Every reader of this journal who is interested in the teaching of psychology should read the book itself. I choose, therefore, to comment on more general issues which it suggests.

Is it wise to divorce the experimental method from the facts of general psychology? Professor Angell's book, like other recent books for beginners, gives no sign that the student is to make any observations systematically or under the conditions of an experiment. It encourages the student to rely on reflection alone—or still worse, on mere memorizing.

Again, is it wise to follow Royce and Stout in choosing the style of the man expressing his own processes of reflection and argument rather than the crisp and objective, if somewhat bald, style of the text-book in physical science? The words *we, us* and *our* occur in this book apparently over three thousand times. A bald fact like 'If sense organs are stimulated, *objects,* rather than mere qualities, are felt,' appears as, "When our attention is called to the fact, we readily notice, as was intimated earlier in the chapter, that if our sense organs are stimulated, we are commonly made conscious of *objects,* rather than of mere *qualities,* such as we have been describing in this chapter" (p. 118).

Does the so-called 'functional' point of view possess any messages of actual fact for the student other than these: (1) That mental life involves not only the existence of thoughts and feelings, but also their connections among themselves and with physical events, and (2) that mental states and their connections have been subject to natural selection? The reviewer is probably wrong, but he finds many of the comments of Professor Angell and others strangely like pure teleology or mere verbalisms. At times they seem even to attempt to explain the origin of variations (at best a ticklish business) by some inner necessity that a need should create its own satisfaction. Are such statements as the following empirical science and, even if they are, will they develop a scientific attitude in students? "Straightway appears consciousness with its accompanying cortical activities, taking note of the nature of the stimulus and of the various kinds of muscular response which it called forth" (p. 51). "Consciousness appears in response to the needs of an organism * * * consciousness brings order out of this threatened chaos" (p. 52). "The organism contains within itself certain *ends* to be attained in course of development by adjustive activities. In part these ends exist imbedded in the physiological mechanisms, where they come to light as reflex, automatic aud instinctive acts, sometimes accompanied by consciousness; and in part they exist as conscious purposes, in which case they appear as recognized intentions" (pp. 75–76). "Left to itself, any mental condition would convert itself at once into some kind of muscular movement" (p. 310). "We have already noted its [emotion's] appearance under conditions of stress and tension requiring new conscious coordinations in order to permit progress, and we have connected this fact with the service of emotion as a general monitor reporting friction and the need of additional intelligent supervision" (p. 327).

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SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for January contains the following articles: 'The Habits of the Striped Meadow Cricket (*Œcanthus fasciatus* Fitch),' Joseph L. Hancock; 'The Embryo of the Angiosperms,' Harold L. Lyon; 'Notes on the Commensals found in the Tubes of *Chætopterus pergamentaceus*,' H. E. Enders; 'On the Larva and Spat of the Canadian Oyster,' Joseph Stafford; 'A Table to Facilitate the Determination of the Mexican Scale Insects of the Genus *Aspidiotus* (Sens. latiss),' T. D. A. Cockerell, besides reviews and notes.

The Popular Science Monthly for March has papers on 'The Bermuda Islands and the Bermuda Biological Station for Research,' Edward L. Mark; 'A Study of the Development of Geometric Methods,' Gaston Darboux; 'Some Present Problems of Technical Chemistry,' W. H. Walker; 'Stamina,' A. N. Bell (dealing with the prevention of tuberculosis); 'The Natural History of Adolescence,' Joseph Jastrow; 'Higher Education of Women and Race Suicide,' A. Lapthorn Smith; and 'Simple Bacteriology for Public Schools,' Lillian Chapin. There are also shorter articles, including one, illustrated, on 'The Inland White Bear,' by W. J. Holland, and another on 'The Carnegie Institution.'

The Museums Journal of Great Britain has a most excellent paper, with valuable discussion appended, on 'Museums and Nature Study,' by Frank Woolnough. The question of lectures by the curators is touched upon and the suggestion made that the nature teaching may best be restricted to the life and geology of its immediate locality. S. L. Moseley tells 'How we made the Keighley Museum Popular,' and in the discussion special stress was laid upon the educational value of museums and the many things a curator is called upon to do. As Dr. Haddon said, 'the curating of a museum is hard work,' the more that like an iceberg it was seven eighths below the surface and none but those who knew realized the extent of the unseen seven eighths. The balance of the number is filled with reviews and notes.

THE contents of *The Journal of Infectious Diseases* for March are as follows:

HARBITZ, FRANCIS: 'Studies in the Frequency, Localization, and Modes of Dissemination of Tuberculosis, with Special Reference to its Occurrence in the Lymph Nodes and During Childhood.'

HEKTOEN, LUDVIG: 'Experimental Measles.'

NOVY, FREDERICK G., and MACNEAL, WARD J.: 'On the Trypanosomes of Birds.' (With Plates 1–11.)

WHERRY, WILLIAM B.: 'Some Observations on the Biology of the Cholera Spirillum.'

MUSGRAVE, W. E., and CLEGG, MOSES T.: 'Amebas: Their Cultivation and Etiological Significance.' (With Plate 12.)

MCCLINTOCK, T. C., BOXMEYER, CHARLES H., SIFFER, J. J.: 'Studies on Hog Cholera.'

THE London *Times* has established an engineering supplement to be issued weekly. The first number, which appeared on March 1, contains articles on 'British Engineering,' by Sir Charles McLaren; 'Submarines,' by Sir William White; 'The Motor Omnibus,' by C. W. B. Little, and numerous other articles and notes.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE section met in conjunction with the New York Section of the American Psychological Association on January 30, afternoon and evening. Professor Woodbridge presided. The following papers were presented:

Color Preferences: R. S. WOODWORTH and FRANK G. BRUNER.

Tests of different races, made at the St. Louis Exposition, showed that red was the color most often preferred, both by men and by women, and by all the races tested. The predominance of red choices was very great. Now previous authors have found, in the white race, that red was a woman's choice, but blue that of most men; this difference of result, as between the present and previous authors, is probably due to the different material used for presenting the colors—colored papers having previously been employed, whereas in the present tests use was made of colored worsteds, such as are used in the Holmgren test for color blindness. Special tests showed that the same individual is very likely to express a different preference, according as the colors are presented in paper, worsted, or glass. Many persons were also found to dislike strongly the colors of the rose, the violet, and the sunset, when presented in paper or worsted. The inference is that the 'color-tone' is by no means a compelling factor in determining likes and dislikes of colored objects.

The Relation of Intensity of Sensation to Attention: M. Tsukahara.

In an experimental study of the effects of distraction on the apparent intensity of a stimulus, a new method of distraction was employed. Two sorts of stimulus—the sound of a falling ball and the impact on the skin of a falling hammer—were employed, and sometimes presented simultaneously, so that the attention had to be divided between them. For instance, first a sound was given; next, simultaneously, a sound and an impact; and last an impact alone. The subject was required to compare the intensities of the two sounds and also of the two impacts. The result was that, contrary to the conclusion of Münsterberg, distraction *decreased* the apparent intensity of the stimuli; but this result is so far merely provisional.

Ideas and Temperaments: Dickinson S. Miller.

In the psychology of intellectual bias one may study the individual or type in its relation to a variety of ideas, or the idea in relation to a variety of individuals or types. Attempting the latter with the so-called 'ideas of the French Revolution,' liberty, fraternity, equality, reason, the natural goodness of man, and the rights of impulse, spontaneously advocated in literature, we find that different phases of these ideas must first be distinguished. As regards the ideas in these phases, the sympathy or antipathy of authors is found to depend in a determinate manner on the temperamental type.

Organic Levels in the Evolution of the Nervous System: Robert MacDougall.

The relation of organization to discriminative reaction may be stated in terms of four types, the non-nervous, the ringed nervous, the segmented and the cephalic. The types were described.

Number Habit: Robert MacDougall.

By number habit is meant the distribution of frequency in the recurrence of each of the digits when the choice is determined by mental constitution rather than objective evidence. Previous reports have given two types, a curve (Minot's) in which the changes from figure to figure are slight, presenting a high plateau in the middle of the series with a depression toward either end; and a curve (Dresslar's and Sanford's) in which maxima systematically appear in the odd numbers and minima in the even. From an apparently similar series of guesses in the present case a curve was obtained presenting three different levels. Zero and five formed maxima in relation to which all the other digits fell in a low plateau, and of the rest the even numbers formed maxima and the odd minima throughout.

The Relational Theory of Consciousness: W. P. Montague.

The new movement in favor of a relational theory of consciousness is to be welcomed in the interest of a scientific psychology. It is however seriously hampered by a failure on the part of most of its advocates to realize the incompatibility of any form of idealism with the view that consciousness is a relation between its objects, and not something in which they inhere. Things must be before they can be related, hence if consciousness is a relation no object can depend for its existence upon the fact that it is perceived. In short the realistic theory of the world is a necessary implication of the relational theory of consciousness; while, conversely, if we follow common sense in admitting the objective reality of both primary and secondary qualities, there will be no temptation to treat consciousness as anything other than special relation between an organism and its environment. Realism and the relational view of consciousness are strictly correlative. They are different aspects of the same truth, and can not be defended or understood apart from one another.

Radical Empiricism and Wundt's Philosophy: Charles H. Judd.

Wundt's Critical Realism is closely related in its fundamental positions to James's recent philosophical discussions. Reality and immediate experience are made synonymous by Wundt. The concept of consciousness is not like the concept matter of the physical sciences, but includes only the immediate processes of experience in their totality. On the basis of these closely related fundamentals Wundt develops the details of his system in such a way as to emphasize the distinctions between physical and psychical phenomena while James strives to minimize these distinctions.

R. S. Woodworth,
Secretary.

THE TORREY BOTANICAL CLUB.

Minutes of a meeting held February 14, 1905, at the American Museum of Natural History.

The first paper, which was illustrated by lantern slides, was by George H. Shull and was entitled 'Stages in the Development of *Sium cicutæfolium*.' Dr. Shull presented briefly the great range of leaf-form in this species at different stages of growth, concluding that these various stages give no safe indication of ancestral forms.

The life cycle of *Sium* fits it for the conditions under which it grows at different stages of its growth, it being mesophytic, hydrophytic and xerophytic in turn. This cycle of changes seems to be independent of external conditions and proceeds regularly without regard for the environment. The consideration of a number of rejuvenated buds shows that rejuvenescence may be brought about by submerging senescent buds in water, and that the later the stage of senescence the earlier will be the juvenile forms which are induced to appear. Evidences were presented tending to prove that the proximal leaflets of pinnate leaves are homologous in any series of leaves taken from the same plant and that the other leaflets are likewise homologous, counting from the proximal pair.

The paper was the subject of considerable discussion.

The second paper was by Tracy E. Hazen, on 'Recent Advances in the Phylogeny of the Green Algæ.' The subject was introduced by a sketch of Borzi's group Confervales, now enlarged into the class Heterokontæ, comprising genera showing natural affinities, taken from the three old orders Protococcales, Confervales and Siphoneæ. This new class, accepted by all recent investigators, serves to indicate the artificiality of the traditional classification.

The clearer lines of descent of the chief groups of Chlorophyceæ from the unicellular, motile *Chlamydomonas* were traced; the first tendency in the direction of aggregations of motile cells finding its highest expression in *Volvox;* the second tendency, in the direction of septate cell division, to form non-motile bodies of increasing solidarity, leading through the Tetrasporaceæ to the Ulvaceæ, which have been placed in a separate order, Ulvales, by some recent authors, and finally, through such forms as *Stichococcus,* to the typical filamentous and branched forms culminating in *Coleochæte.* The third or *Endosphærine* tendency from *Chlamydomonas* as suggested by Blackman, was held by the speaker to furnish an unsatisfactory origin for the Siphoneæ, inasmuch as the endophytic forms associated with *Endosphæra* may be regarded as too specialized in their mode of life at least. It is much more natural to derive the Siphoneæ from the septate, multinucleate Cladophoraceæ. The latter group may well be regarded as an intermediate order, easily derived from the Ulotrichaceæ through such forms as *Hormiscia* (*Urospora*) and *Rhizoclonium.*

The recent proposition of Bohlin and Blackman to regard the Œdogoniaceæ as forming a class derived from a separate unicellular ancestor is at least premature, and it does not appear at all impossible that this group may have been derived from a *Ulothrix*-like form as suggested by Oltmanns. The Conjugatæ furnish a perplexing problem, but the speaker preferred to regard this group as forming an order of Chlorophyceæ rather than as a separate class, in view of present evidence.

Edward W. Berry,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The fifth meeting of the club for the year 1904–5 was held in the large auditorium of University Hall, on February 23, at 7:30 P.M. The paper of the evening, by Dr. U. S. Grant, of Northwestern University, dealt with the subject 'The Lead and Zinc Mines of Southwestern Wisconsin.' Dr. Grant presented the main results of a careful survey of this region, which during late years has again become an important factor in the domestic lead and zinc production. The work was done under the direction of the Wisconsin Geological and Natural History Survey and a full account of the results obtained will be given in the near future in a bulletin published by the survey. The paper was discussed by various members of the university faculty and others, after which a business meeting of the club was held.

F. W. Woll,
Secretary.

DISCUSSION AND CORRESPONDENCE.

BLUNDERS IN THE SCIENTIFIC RECORDS.

The systematic zoologist and zoogeographer of to-day who is trying to utilize for generalizations the facts which have been accumulated by previous generations is constantly baffled—and often led astray by the insufficiency of the material gathered, the lack of detail and accuracy in the labeling, and the often downright erroneousness in the recording. The last is particularly vexatious, because once put into print, it is almost impossible to eradicate such errors. The everlasting recurrence in zoogeographical text-books of the allusion to the toad once falsely stated to have come from the Hawaiian Islands, and to the two-handed lizard alleged to inhabit Colorado, are familiar examples of these undying errors.

A rather flagrant case of erroneous locality record was exposed some time ago. In 1881 Dr. Victor-Lopez Seoane startled the zoological world by describing a boid snake from the Philippine Islands. It was stated to have been collected by his brother at Manila, and to say that the case puzzled the zoographers is to put it mildly. It was soon discovered that it belonged to a West Indian genus, *Epicrates*, and in my 'Herpetology of Porto Rico' (1904) I showed conclusively that the snake must have come from Porto Rico, being identical with *E. inornatus* which is peculiar to that island. Dr. Seoane's brother is a Spanish naval officer, a general in the marine corps, and this circumstance explains the mixing up of the Philippine and the Porto Rican localities.

A parallel to this blunder has just come under my notice. In 1890 Dr. Seoane again described (in the *Mémoires de la Société Zoologique de France*, III., p. 260, pl. vi) a new species from the Philippine Islands, collected by the same brother. This time it was a toad which received its name, *Bufo panayanus*, from the island of Panay, the alleged type locality being Iloilo. He correctly compared it with *B. gutturosus* from Santo Domingo, but failed to profit by this resemblance to the West Indian species, of which he regarded it as the 'oriental pendant.' While recently completing a list of Philippine batrachians and, therefore, looking up the original records, I was struck by the similarity of Seoane's figures to the Porto Rican toad *Bufo lemur* and a comparison with specimens of the latter easily demonstrated their identity. The relationship to *Bufo gutturosus* from Haiti, which is quite close, is thus easily accounted for, and the 'oriental pendant' done away with. *Bufo panayanus* finds a final resting place in the synonymy of *Bufo lemur*, and the list of Philippine batrachians is one species poorer!

Leonhard Stejneger.

U. S. National Museum,
Washington, D. C.,
March 6, 1905.

THE METRIC FALLACY.

To the Editor of Science: Evidently Mr. Samuel S. Dale, in the issue of Science of March 3, 1905, under the above title, failed to recognize his own mathematical proof of the amount of saving in time that might accrue in school with the use of the decimal system.

His error probably arose through the use of an artificial week by the board of education merely for their own convenience in assigning the proportion of time in school for each study. The time a child actually spends in school is a small part of the year and it would be a confusion of units to compare this schedule week with a regular week because the same word is used.

The only way a comparison can rightly be made is to take Mr. Dale's statement of what the schedule week is in years—that is, for elementary mathematics thirty-four and one eighth schedule weeks require eight years' work. On this basis 6.825 schedule weeks will require one and three fifth years' work in mathematics.

It is, however, not necessary to introduce this schedule week. The pupil actually spends eight years, according to Mr. Dale, on the text-books mentioned. As arithmetic during all this time is a major study, it is taught to the full capacity of the average child. Now if twenty per cent. of this time, as is allowed by Mr. Dale, is spent on tables of weights and measures, evidently these will require all the time available for mathematics during 1.6 years.

It is probable that a child could easily learn the decimal system in less than half the time it takes to learn both the decimal system and the several other unconnected tables. Accepting Mr. Dale's own figures, it seems, therefore, reasonable to suppose that the average pupil would save from two thirds of a year to one year of the one and three fifth years, now required, and would be about a year ahead in mathematics at the end of the eight years if he had only the decimal system to learn.

I do not desire to enter upon any discussion as to the merits of the metric system, but simply to point out the mathematical error in Mr. Dale's reasoning and to show that if his argument was worth anything at all, it really proved the very statement he was trying to refute.

Henry B. Hedrick.

U. S. Naval Observatory,
Washington, D. C.,
March 9, 1905.

A REQUEST FOR MATERIAL.

I have been at work for some time upon the problem of double monsters among animals and would be grateful for any material coming under this head. I wish instances of genuine double monsters, *i. e.*, those involving the doubling of some axial part of any vertebrate, embryonic or adult (naturally, not too large specimens), and am just now especially desirous of cases among birds. As this is the time of year at which embryological laboratories run their incubators, it seems likely that several such instances will be found by those not especially interested in the subject and who do not care to investigate them. If any such material appears superfluous I will try to make good use of it.

Harris Hawthorne Wilder.

Smith College,
Northampton, Mass.

SPECIAL ARTICLES.

ELLIPTICAL HUMAN ERYTHROCYTES. (A SUPPLEMENTARY STATEMENT.)

On March 18, 1904, I published in Science a note describing an unusual variation in the shape of human erythrocytes. As was stated in that article, the blood of a student at the Ohio State University contained elliptical red corpuscles, whose average length was 10.3 microns and whose average width was 4.1 microns. About 90 per cent. were thus deformed. The observation attracted considerable attention, Professor Austin Flint being one among several who wrote to me for a specimen of the blood. There resulted some correspondence between Professor Flint and myself, and in a letter to him I remarked that some time after my observations had been made the young man having these elliptical corpuscles had died. Since the claim had been made that the young man (a mulatto) was healthy when these corpuscles were discovered, the statement about his death naturally aroused some suspicion. Professor Flint wrote a note in SCIENCE, May 20, 1904, discussing the matter of form changes in the erythrocytes, and pointing out that in progressive pernicious anemia, and other blood diseases, the variations in form and size are well-known facts. He adds: 'In view of these facts, it seems impossible to accept the proposition that the subject of the observation was a *healthy* mulatto.'

It has been my intention to supply the information about the death of the subject of this observation, but for various reasons it has not been possible to do this with certainty until the present time. I am now able to state that the cause of death was cardiac failure subsequent to an attack of acute inflammatory rheumatism. As is often the case, the attack was preceded by tonsilitis, which began about three months after my observation had been made. Consequently, there was no connection between the condition of the corpuscles and the cause of death.

I wish to add some further points to substantiate my claim that the subject of the observation was healthy at the time the corpuscles were described. In the first place, his general physical condition indicated it. He was able to make his living by manual labor, and was studying hard to maintain his standing in his classes. He complained of no illness. As to his blood, it is to be noted that I said that the number of red and white corpuscles was normal, and that the quantity of hæmoglobin was normal. There were no normoblasts nor megaloblasts. On the other hand, when the corpuscles were observed in the fresh state, the uniformity of the elliptical shape was the remarkable feature. The poikilocytosis, to which Professor Flint refers, was much more prominent in the dried specimens. Now it is a well-known fact that there are no cells more susceptible to influences than the blood corpuscles, and, therefore, the poikilocytosis shown in my dried specimens can not be given much weight.

Speaking further about the form variation of red corpuscles, I would say that it is a question about which opinions differ considerably. However, it is not my intention to discuss that point further than to make a few statements bearing upon this particular case. Professor Flint quotes from Ewing's 'Pathology of the Blood,' p. 256, as follows: 'Some times in non-infectious purpura hemorrhagica the red corpuscles are undersized and many are oval.'

I may say in this connection that Professor Ewing saw a specimen of this blood of which I write, and he was of the opinion that the anomaly was one of congenital or developmental origin. He based his view in the first place upon the fact that the number of corpuscles and quantity of hæmoglobin were normal, and in the second place upon the general condition of the individual himself. The subject certainly did not have purpura. And further, I may add that while in Germany recently I had an opportunity to show the same specimen to several men, among them being Ehrlich. The opinions of these men differed somewhat, but in only one instance did doubt arise as to the health of the subject. With this one exception (and the man was not a pathologist, by the way), the specimen did not suggest pernicious anemia nor purpura. Dr. Arneth, in Würzburg, a man who has made several thousand blood slides from a great variety of clinical cases, had not seen such a specimen. One pathologist of considerable reputation thought that the shape was an artifact. He was doubtless influenced by the work of Weidenreich, who claims that the mammalian erythrocyte is not normally biconcave, but bell-shaped. Weidenreich attributes the biconcavity to the corpuscle's extreme 'Empfindlichkeit,' by virtue of which, with slight increase in the density of the plasma or other fluid, the biconcavity arises by loss of water from the corpuscles.* If his work be confirmed by later investigations it would have an important bearing, not only upon this variation which I report, but upon all clinical observations of form changes in the red cells. I do not think that the variation I have described was an artifact, however, and my

* Weidenreich, *Arch. f. Mik. Anat. u. Entwick.*, 1903, p. 459.

opinion is strengthened by that of Ehrlich, who, on the ground of the uniformity of the elliptical shape, concluded that it had been preformed in the individual. As to the cause of the anomaly, Ehrlich did not commit himself. In conclusion, I wish to state the following views about the case:

1. The variation recorded occurred in a healthy individual. His good general physical condition, the normal number of red and white cells, the normal quantity of hæmoglobin, and the absence of megaloblasts, megalocytes and normoblasts, preclude the idea of any known blood disease being connected with the phenomenon.

2. The anomaly was probably one of congenital or developmental origin. Ewing holds this view for reasons stated above. It is unfortunate that no family history could be obtained to throw light upon this point, except that a brother of the subject had normal corpuscles.

3. In the light of Weidenreich's work, it is possible that the elliptical shape was an artifact. Ehrlich and others, including Professor Bleile and myself, do not hold this view. It would be strange that such a remarkable variation would occur so uniformly over so long a period. (As was stated in the former article, my observations extended over a period of four months, and the corpuscles were discovered two months before a systematic study was begun.)

4. It is possible that this variation was antecedent to the onset of pernicious anemia or some other blood disease. That would make the deformity none the less remarkable, for there were absolutely no symptoms, at any time, of any incipient illness.

5. So far as the writer has been able to ascertain, this is the first case of the kind recorded. However, Ewald, of Strassburg, writes that he thinks a similar observation was made at Königsberg twenty or thirty years ago. I have not been able to find any written record of such an observation.

MELVIN DRESBACH.

DEPARTMENT OF PHYSIOLOGY,
OHIO STATE UNIVERSITY.

QUOTATIONS.

COMPULSORY GREEK AT CAMBRIDGE.

THE University of Cambridge has declined, by a considerable majority, to make Greek an optional, instead of, as at present, a compulsory, subject in the previous examination. The decision was not unexpected; and probably now the whole question will enter on a new phase. Though sympathizing with the aims of the proposers of the graces, we have already expressed the opinion that it was perhaps a mistake to raise so great a question as the place of Greek in higher education upon the comparatively minor issue of the regulations for a pass examination, in which all that has to be considered is a *minimum* of attainment. This, as Professor Butcher has pointed out, is not the way to estimate the value to the community of any branch of academic learning, be it Greek, mathematics or science. But in the present examination-ridden condition of higher education in England our educational authorities seem unable to think of learning or study except in terms of examination, with the result that, in Professor Butcher's words, when it is desired to modify the existing relation of Greek to university studies, 'a single examination is tinkered, without any regard to its bearings on the university course as a whole.' There has been very little attempt to lay down definite lines of study, and then consider the preliminary examination at entrance in its relation to different curricula. Because the exaction of a *minimum* attainment in Greek is now found to press hardly upon certain students without any corresponding advantage of literary culture, it was proposed at Cambridge to give an unrestricted option to all candidates, with no distinction between students of literature and of science, of different lines of study and of different curricula. The more limited proposal rejected a short time ago by the University of Oxford at least recognized the principle of adjusting the entrance examination to certain lines of academic study; but it was too limited and partial in its scope, and its adoption would have gone but a very little way towards a solution of the problem. What is wanted now in the interests of higher education generally is not a mere tinkering with responsions or the previous examination, but to lay down by what avenues of study a university degree may be approached and how the various examinations may be adjusted to them. 'Compulsory Greek' is but an incident of this larger question.—The London *Times*.

STUDENTS OF THE GERMAN UNIVERSITIES.

A CONSULAR report states that this winter semester there are in Germany 39,716 matriculated students, against 39,581 during the past summer semester, and 39,718 last winter. At the beginning of the nineties there were in round numbers 29,000 students, and in the winter of 1894–95, 28,105; the third ten thousand was not reached until the winter 1897–98, when the number was 31,110, since which time there has been a steady increase until now, when the fourth ten thousand has been nearly reached. The numbers of those in attendance at the several universities during the winter semester 1894–95, the present winter semester, and the two previous semesters, were as follows:

University.	Winter 1894–95.	Winter 1903–4.	Summer 1904.	Winter 1904–5.
Berlin	5,031	7,503	6,096	7,774
Munich	3,475	4,906	4,946	4,766
Leipzig	2,985	3,772	3,575	3,880
Bonn	1,518	2,294	2,818	2,568
Halle	1,539	1,753	1,780	1,881
Breslau	7,293	1,770	1,800	1,870
Göttingen	804	1,370	1,581	1,574
Freiberg	1,136	1,331	2,029	1,501
Tübingen	1,165	1,387	1,581	1,407
Strassburg	949	1,333	1,299	1,395
Heidelberg	1,028	1,359	1,655	1,371
Würzburg	1,347	1,283	1,322	1,295
Marburg	800	1,154	1,421	1,276
Münster	411	1,204	1,255	1,256
Giessen	528	1,071	1,093	1,069
Jena	635	816	1,024	953
Erlangen	1,131	982	373	942
Königsberg	709	925	1,018	932
Kiel	504	758	1,000	745
Greifswald	750	687	775	705
Rostock	420	519	540	556

The number of students pursuing different subjects was:

	Number of Students.	
	1894–95.	1904–05.
Law	7,380	11,777
Philology and history	3,083	8,322
Medicine	7,768	5,906
Mathematics and science	2,525	5,688
Evangelical theology	3,083	2,136
Catholic theology	1,404	1,678
Pharmacy	1,214	1,387
Agriculture	883	1,055
Forestry	413	1,024
Dentistry	282	596
Veterinary surgery	70	149
Total	28,105	39,718

THE GEOGRAPHICAL AND GEOLOGICAL SURVEY OF SAO PAULO.

THE state of Sao Paulo, Brazil, has since 1886 maintained a Geographical and Geological Survey, the only organization of its kind on the South American continent, which up to the present time has made a detailed topographical map of nearly a third of its territory and made geological contributions that have attracted world-wide attention. Later the government of the same state established an engineering school with the title of Escloa Polytechnica de Sao Paulo that aspires to be, and in many respects is, one of the first of its kind on the continent. A correspondent informs us that about four years ago a group of professors of the newly organized school initiated a campaign to undermine the older organization. The organizer and chief of the survey, Dr. Orville A. Derby, has been forced to resign, being accompanied by the chief topographer, Dr. Horace E. Williams, and by the largest and best part of the topographical staff. A railroad engineer has been appointed to succeed Dr. Derby and the government of the state, while announcing its intention of greatly improving the service, is now wrestling with the problem of mapping its territory without trained topographers.

THE PROGRAM OF STUDIES OF COLUMBIA COLLEGE.

THE trustees of Columbia University have this month adopted a new program of studies for the college on the recommendation of the faculty.

The degree of bachelor of science, as well as that of bachelor of arts, will hereafter be open to students in the college. Candidates for the B.S. degree will not be required to offer any ancient language at entrance or to pursue the study of an ancient language in college, but such students must devote an equivalent time to the study of the natural and physical sciences.

After a student has made 72 points of the 124 required, which he can do in two years, (1) he may take the studies of the first year of the Schools of Applied Science and receive the degree of A.B. or B.S. upon the completion of two years' work; (2) he may take the studies of the first year of the College of Physicians and Surgeons, and receive his A.B. or B.S. upon the completion of two years' work; (3) he may take the studies of the first year of the professional course of Teachers College, and receive his A.B. or B.S. after two years' work; or (4) he may take the studies of the first year in the School of Fine Arts, and receive his A.B. or B.S. after two years' work. When a student has received 94 of the 124 points he may take the studies of the first year of the School of Law; and receive the degree of A.B. or B.S. upon the satisfactory completion of one year's work in this course.

The student who obtains the mark A in any two courses in one half year will be entitled to receive one point of extra credit, provided he has not fallen below the mark B in any of the courses pursued by him during the half year. A student who receives the mark D in two or more courses in any half year is to be given credit for but one of these courses.

Students will be regularly admitted to the freshman class at the beginning of the second half year in February, as well as at the beginning of the first half year in September. The work of one half year may be satisfied by the entrance examinations. Examinations for admission will be held in January of each year. A half year is made the unit for courses.

The first two years are practically prescribed, seven different subjects being required in the freshman year. The prescribed studies are: English, five hours; French or German, three hours; history, three hours; mathematics, three hours; philosophy, three hours; physical education, two hours; science, three hours; and either Latin or an additional course in science, three hours, according as the student is a candidate for the A.B. or B.S. degree. The courses of the last two years are elective, and as indicated above, the courses of the professional schools may be elected.

SCIENTIFIC NOTES AND NEWS.

A grant of $150,000 has been authorized by the Carnegie Institution for the Solar Observatory on Mt. Wilson, and it is expected that the first equipment will cost about twice this sum. The present staff of the observatory is: George E. Hale, director; G. W. Richey, astronomer and superintendent of instrument construction; Ferdinand Ellerman, assistant astronomer, and Walter S. Adams, assistant astronomer. The address of Messrs. Hale and Ritchey is Pasadena, and the address of Messrs. Allerman and Adams is Mt. Wilson. Professor Barnard is also at work temporarily on Mt. Wilson with the Bruce photographic telescope of the Yerkes Observatory.

Professor F. L. O. Wadsworth has resigned his position as director of the Allegheny Observatory because of the lack of funds required to properly carry on the work of that institution. For this reason all work has been suspended at the observatory for more than a year, except that of taking routine time observations. Professor Wadsworth has been appointed general manager of the Pressed Prism Plate Glass Company and is now at Morgantown, W. Va.

Senhor Manuel Garcia celebrated his hundredth birthday on March 7 in excellent health. He gave the first performance of Italian opera in New York City in 1825, and was long celebrated as a teacher of singing. His important contribution to science was the invention of the laryngoscope fifty years ago. Senhor Garcia was presented with a portrait of himself by Mr. John S. Sargent and received a number of congratulatory addresses with decorations from King Edward, Emperor William and the King of Spain.

The University of Glasgow will confer its doctorate of laws on Dr. Alexander Crum Brown, professor of chemistry at Edinburgh.

Professor W. H. Burr, of Columbia University, has been appointed consulting engineer of the New York City aqueduct commission with a salary of $6,000.

Professor W. T. Sedgwick, of the Massachusetts Institute of Technology, has gone to Europe on leave for six months. His European address is in care of Messrs. Baring Bros., Limited, 8 Bishopsgate St., London, E. C.

Dr. W. J. Holland, the director of the Carnegie Museum, sailed for England on March 18. He repairs to London to install the reproduction of the great skeleton of Diplodocus which he has made from the original in the Carnegie Museum. It will be placed in the gallery of reptiles at the British Museum. Mr. Carnegie will formally present the restoration, which has been made at his expense, to the trustees of the British Museum some time in May. The total length of the vertebral column, including the skull, is eighty-four feet, exceeding the dinosaur Brontosaurus in the American Museum of Natural History by nearly twenty feet. Dr. Holland is accompanied by Mr. A. S. Coggeshall, the chief preparator in the section of paleontology in the Carnegie Museum.

Professor E. A. Minchin, Jodrell professor of zoology in University College, London, has undertaken to conduct further investigations, under the auspices of the Royal Society's committee, into the causation of sleeping sickness in the Uganda Protectorate.

Under the auspices of the department of economics of Harvard University Professor W. F. Willcox, of Cornell University, who acted as expert in charge of methods and results in the United States census of 1900, will give three public lectures during the last week of the month on some phases of the census investigations. The subjects will be: 'The Population of the United States,' 'Some Statistical Aspects of the Negro Problem' and 'The Birth Rate and Death Rate of the United States.' The exact hours and place will be announced later.

Professor David Eugene Smith, of Teachers College, Columbia University, has recently purchased the library of Professor Ferinando Jacoli, of Venice, and has added it to his own collection for the use of his students. The library is particularly rich in the history and teaching of mathematics, containing many rare editions. Professor Smith has at the same time made available for study his rare collection of portraits and manuscripts of celebrated mathematicians, the largest that has been brought together.

The Board of Estimate of New York City has appropriated $5,000 to estimate the epidemic of cerebro-spinal meningitis. A commission has been named for this purpose as follows: Dr. William M. Polk, chairman, dean of Cornell Medical College; Dr. Walter B. James, professor in the College of Physicians and Surgeons; Dr. William P. Northrup, professor in Bellevue Hospital and at New York University; Dr. Simon Flexner, head of the Rockefeller Institute; Dr. Joshua M. Van Cott, pathologist at the Long Island College; Dr. E. K. Dunham, pathologist of Carnegie Laboratory, and Dr. William K. Draper, visiting physician at Bellevue and Minturn Hospitals.

The first Herbert Spencer lecture, established by Pandit Shyamáji Krishnavarma, M.A., of Balliol College, was given at Oxford, on March 9, by Mr. Frederic Harrison, M.A., honorary fellow of Wadham College.

We regret to record the deaths of Dr. Hjalmar Stolpe, the ethnologist of Stockholm; of Dr. Ludwig von Tetmajer, professor of mechanics in the Technical Institute of Dresden, and of M. Emile Fernet, a French physicist, for many years editor of the *Comptes Rendus* of the Academy of Sciences.

The position of assistant in the clinical laboratory of the New York State Pathological Institute will be filled by civil service examination on April 8. The salary is $1,500.

The second section of the museum building, near the Prospect Park Plaza, Brooklyn, has been completed and provided with cases and furniture at an expense to the city of New York of upwards of $600,000. It is expected that this section of the museum will be turned over by the city to the Brooklyn Institute of Arts and Sciences very soon.

THE French government has proposed to the chamber of deputies to create a Universal Exposition in Paris in 1920 to commemorate the foundation of the French republic.

THE daily papers state that the Duke of Orleans is preparing an Arctic expedition, and has offered to purchase the *Fram* of the Nansen expedition. The Norwegian government has, however, declined to sell it.

IN order to avoid clashing with the International Tuberculosis Congress, which is to be held this year in Paris from October 2 to 7, the organizing committee of the French Congress of Medicine has decided to change the date of meeting from October 2, 3 and 4, to September 25, 26 and 27.

IT is said that United States food laboratories will be established in Boston, Orleans and San Francisco similar to the one recently opened in New York City.

A METEOROLOGICAL observatory in the Transvaal has been established near Johannesburg, with Mr. R. T. A. Innes as director.

THE Lake Laboratory of the Ohio State University announces for its summer work in biology at the Cedar Point Laboratory, near Sandusky, courses of instruction in general zoology and botany and advanced courses in comparative anatomy, embryology, entomology, ichthyology, ornithology, experimental zoology, ecology and special work in botany. The staff includes, besides the director, Professor F. L. Landacre, of the Ohio State University; Dr. W. E. Kellicott, Barnard College, Columbia University; Professor L. B. Walton, Kenyon College, and Mr. O. E. Jennings, curator of botany at the Carnegie Museum, Pittsburg. The course in experimental zoology, under the charge of Dr. Kellicott, of Columbia University, is a new feature in the work. As heretofore special attention will be given to the opportunities for investigators, those doing independent work being allowed free use of the laboratory with the expectation that each will furnish his own microscope and other apparatus or materials used in his investigation. The instruction courses open on June 26 and close on August 4, and the laboratory will be open for investigators from June 26 to September 15. Detailed information may be obtained by addressing the director, Professor Herbert Osborn, Ohio State University, Columbus, Ohio.

THE London *Times* states that the French Ministry of Public Works has commissioned M. Jacquier to project plans for a railway between Chamonix and Aosta. He considers the difficulty would not be so great as with the Simplon tunnel; the tunnel would be 4½ miles shorter, and the rock gives no indication of subterranean reservoirs of water. The tunnel would commence at Chamonix, 3,415 feet above sea level, and end at Entrèves (4,550 feet), a distance of 8½ miles. The Dora Baltea would give ample water power for the boring work, and afterwards for locomotion.

ACCORDING to foreign exchanges, the Danish government has begun a survey of Iceland. Much of Iceland has never been accurately surveyed, triangulation having been carried out in only a few parts of the island. The least known region is the southern coast, which is impassable in summer owing to the quicksands, and also the inland ice-masses of the Vatna Jökull, and it is here that a beginning has been made with the survey. During the summer of 1903 a plan of the survey was laid down by means of a preliminary expedition, and in the spring of 1904, so long as the frosts made it possible to cross the morasses and streams, a part of the southern region in the district of Skeideraasande was surveyed. A second survey party was detailed to study the inland ice. One result of the work was to show that the highest point of the island is Hvannadalshnukr, which is 2,120 meters, and not, as has been hitherto supposed, the Oraefa Jökull, which is only 1,959 meters. In all about 100 Danish square miles, that is 5,700 square kilometers, have been already surveyed.

REUTER'S AGENCY is informed that Mr. A. E. Pratt, who lately returned to England from a two years' expedition in the remote interior of British New Guinea, chiefly along the Owen Stanley Range, has sailed on a new scientific expedition, which is expected to last for two and a half years. Mr. Pratt, accompanied by his two sons, proceeds direct to Batavia, where he will make final arrangements for his journey. After conferring with the Dutch government officials he will cross to Dobo, the chief town of the Aru Islands, a group unknown to Europeans. After making collections there the expedition will cross to Dutch New Guinea and will immediately strike into the interior with the object of reaching the highest possible point of the Charles Louis Range, a snow region running east and west of Dutch New Guinea never before explored. Valuable geographical results are expected, and a map will be made, but the special work of the expedition will be the collecting of natural history specimens.

The council of the Royal Meteorological Society arranged to hold an exhibition of meteorological instruments from March 14 to 17. The exhibition was chiefly devoted to recording instruments; but it also included new meteorological apparatus invented or first constructed since the society's last exhibition, as well as photographs, drawings and other objects possessing meteorological interest.

UNIVERSITY AND EDUCATIONAL NEWS.

The will of Mrs. Jane Lathrop Stanford gives about $3,000,000 to relatives, and about $100,000 to charities. The residue of the estate, which it is said will amount to about $2,000,000, is bequeathed to Leland Stanford Junior University. The university also comes into possession of the house built by Senator Stanford at San Francisco and its contents, which are valued at more than $2,000,000.

It is now said that Sir William MacDonald, of Montreal, has decided to give $4,000,000 to the cause of education and has unfolded his scheme in detail. It consists of the erection of a normal school at St. Anne de Bellevue, a few miles distant from Montreal, and the erection and endowment of an agricultural college at the same place, to the plans for which we have already called attention.

The legislature of North Carolina, which adjourned on March 7, appropriated $50,000 for the erection of a chemical laboratory at the University of North Carolina. The plans for this laboratory have been accepted and work will begin at once.

The Boys' Central High School of Philadelphia was injured by fire to the extent of $100,000 on March 9. The equipment of the astronomical department suffered especially, the loss there being estimated at $30,000, in addition to books and manuscripts belonging to Professor Monroe B. Snyder.

Mr. Shyamáji Krishnavarma has offered to establish six traveling fellowships at Oxford, five of them to be called the Herbert Spencer Indian fellowships. The fellowships are intended for natives of India.

Mr. Edward Whitley, B.A. Trinity College, has given £1,000 towards the permanent endowment of the chair of physiology in the University of Oxford.

At St. Petersburg, Moscow, Kieff, Kharkoff, Kazan and other large towns having universities or technical colleges, these institutions have been closed by order of the authorities.

Meetings are being held between the medical faculties of McGill University and the Bishop's College University, Montreal, looking toward the amalgamation of Bishop's medical faculty with that of McGill University.

The Thaw fellowship in astronomy at Princeton University is open for the coming academic year to college graduates of not more than five years' standing. The income of the fellowship is five hundred dollars a year; the holder is expected to devote his entire time to graduate work and research, and will be eligible to reelection. Applications with credentials should be received by the dean of the graduate school before the first of May.

Dr. R. S. Woodworth, instructor in psychology in Columbia University, has been promoted to an adjunct professorship.

Mr. James C. Irvine, Ph.D., D.Sc., has been appointed to the new lectureship in organic chemistry in St. Andrews University.

Dr. Paul Drude, of Giessen, has accepted a call to a professorship of physics at Berlin.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE SIXTH ANNUAL MEETING OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS.

THE sixth annual meeting of the Society of American Bacteriologists was held at the Laboratory of Hygiene, University of Pennsylvania, Philadelphia, Pa., on December 27 and 28, 1904.

The opening address was by President F. G. Novy, of the University of Michigan, on 'The Hematozoa of Birds.'

On the Hematozoa of Birds: F. G. NOVY, University of Michigan.

An abstract or partial summary of the results obtained in this study appeared in *American Medicine,* November 26, 1904. The work in full will come out in two papers, the first of which, dealing with the Trypanosomes in birds, will appear in the second number (1905) of the *Journal of Infectious Diseases;* the second paper, dealing with the Cytozoa, may be expected in the third number of that journal.

The Effect of Freezing on Bacteria: ERWIN F. SMITH and DEANE B. SWINGLE, U. S. Department of Agriculture.

More than 100 freezings were made using about a dozen different bacteria—saprophytes and plant and animal pathogenic forms. Quantitative determinations were made in all cases. With the exception of *Bacillus radicicola,* all of the exposures were made in +15 peptonized beef bouillon, using cultures 24 to 48 hours old. Part of the freezings were made in liquid air, the time of exposure varying from 10 minutes to 24 hours, but usually one half hour. The rest were made in salt and pounded ice, the time of exposure being 2 hours. The freezings were made in 5 c.c. portions of bouillon in test-tubes of resistant glass. The thawings were made in tap water at 16° to 18° C. The inoculations for each set of plates were made in the same way, *i. e.,* usually with the thinnest meniscus it was possible to obtain across a 1-mm. platinum oese. The petri dishes were carefully selected, those taken being approximately 9 cm. in diameter, with flat bottoms. The regular method of work was to make three poured plates (checks) from the inoculated tubes after insuring thorough diffusion, which was obtained by stirring with the platinum rod, shaking and allowing to stand one half hour. The tube was then immediately lowered into the liquid air and frozen slowly from the bottom up to avoid cracking. (This usually required four minutes.) As soon as the one half hour or other predetermined time of exposure had elapsed, the tube was removed, warmed for about 3 minutes in the laboratory air and then thawed in water (which usually required another 5 minutes). As soon as the thawing was completed, three more poured plates were made, and these together with the three check plates were then incubated in the dark at 30° C., until the colonies were in good condition for counting—a period varying, according to the species, from one to several days. The plates were all put on a leveling apparatus as soon as poured, and in general the distribution of the colonies in the nutrient agar was very uniform. When the plates were sown thin enough, the entire surface was counted (60 sq. cm.); for the thicker sowings the average of 10 or 12 sq. cm. was used, or of one half the plate. The following samples from two of the thirty or more slides exhibited will give a general idea of the method and results:

BACILLUS TYPHOSUS. (SIX POURED PLATES.)

Colonies per Square Centimeter:

	Before Freezing.	After Freezing (2 hrs. in Salt and Ice).
Plate I	46	2/60
Plate II	39	0
Plate III	42	2/60
Average	42	1/45

Per cent. killed, 99.5.

Frozen, Dec. 15. Incubated at 30° C. Counted, Dec. 19.

BACILLUS TYPHOSUS. (SIX POURED PLATES.)

Check on Salt and Ice, *i. e.*, 1/2 of Same Culture.

Colonies per Square Centimeter:

	Before Freezing.	After Freezing (2 hrs. in Liquid Air).
Plate I	50	1/60
Plate II	51	3/60
Plate III	43	2/60
Average	48	2/60

Per cent. killed, 99.3.

Frozen, Dec. 15. Incubated at 30° C. Counted, Dec. 19.

The following conclusions may be drawn: (1) The effect of very low temperatures has been greatly overestimated. As destructive results were obtained with salt and pounded ice (—17°.8 C., or less) as with liquid air. (2) The critical point appears to be somewhere around 0° C. If an organism can pass this point in safety, it is believed that even absolute zero (—273° C.) would not harm it. (3) Some individuals of each culture were able to endure unharmed the temperature of liquid air (—190° C.), although this was often only a small proportion of the whole number. (4) Repeated freezings and thawings reduced this number very gradually to nothing, but ten freezings and thawing (in course of eight hours) did not kill all of the individuals of *P. campestris,* although it reduced the number in the bouillon to such an extent that three one-millimeter loops gave three sterile plates. (5) This resistance to freezing is believed to be due to absence of water in the resistant cells, these cells behaving like endospores, although not known to be endospores (*i. e.*, from species not known to produce endospores). Possibly these resistant cells are to be considered as arthrospores. (6) Endospores freed from non-sporiferous vegetative cells by heating in the water-bath for fifteen minutes at 70° C. were not in any way injured by freezing (two species), and this would seem to be an added proof that the protoplasm of such spores is destitute of water, a conclusion already reached by various observers on account of their behavior in boiling water and streaming steam.

So far as any general inference can be drawn from experiments made only in bouillon, we may conclude that bacteria are injured by freezing to very different degrees, behaving in this respect like the higher plants and animals. Many kinds, like *Bacillus typhosus*, are destroyed in great numbers even by short freezings, while other forms, like *Bacillus sorghi*, are rather resistant. The former idea that bacteria in general are not harmed by freezing is untenable. It was based on qualitative tests which are incapable of showing the true state of affairs in the exposed culture. Probably an enormous number of bacteria are destroyed by every winter, and those which survive come through in the form of endospores or some other resistant shape. These experiments confirm and extend those of Prudden, Park and Sedgwick and Winslow. They will be repeated, freezing in water, and will be extended to include some additional species, and will probably be published by the U. S. Department of Agriculture.

The Viability of B. Dysenteriæ Shiga: W. D. Frost and R. Whitman, University of Wisconsin.

Four strains of this organism were tested. One was the Shiga type. The others belonged to the Flexner-Harris type. Of these one was the Harris culture and the others were from Duval and Bassett's series of summer diarrhœa cases. The viability was tested by drying the organisms on articles of merchandise, dried food substances and in sterile distilled water and milk, under various conditions. A summary of the conclusions reached follows: the *B. dysenteriæ* when dried on articles of merchandise, as paper, cloth and wood, dies rapidly in from four to nine days at the temperature of 17–20° C. On dried food substances, as bread, rice and albumin balls, this germ may live for days. In some cases it is able to live over a month. In sterile distilled water the life of the germ is very short, rarely maintaining itself more than a week. In sterile milk the germ can live until the medium is dried up. The different strains vary in their viability under given conditions, the Shiga type culture being distinctly more frail than cultures of the Flexner-Harris type, the effect of temperature in modifying the viability of the germ being important. At a temperature of 38° C. it will live from only one half to one fourth of the time that it will live at a temperature of 17–20° C.

Pseudomonas Campestris (Pam.) Smith: H. A. Harding and M. J. Prucha, Experiment Station, Geneva, N. Y.

Pseudomonas campestris (Pam.) Smith is a yellow non-spore-forming plant parasite. It attacks cabbage, cauliflower and allied plants by way of their fibrovascular system.

A study of its resistance to desiccation showed that while it died when exposed on sterile cover-slips for a few days (in our experiments not surviving a ten-day exposure), it retained its vitality on cabbage seed for more than a year. Apparently no loss of pathogenicity resulted from this long exposure to unfavorable conditions. Cabbage plants inoculated with pure cultures, obtained from seed thirteen months after infection, showed a blackening of the veinlets in the leaf and other evidences of disease at the end of sixteen days.

At a time when so much stress is being laid upon the quickness with which pathogenic organisms are destroyed in nature these observations should tend to check hasty generalizations. (To be published in full in *Centralbl. f. Bakteriol.*, etc., II. Abt.)

The Demonstration of the Flagella of Motile Bacteria and a Simple Method of Making Photomicrographs: Edward W. Duckwall, Aspinwall, Pa.

I found that the methods for flagella staining described by the old authors had to be modified. I divided the motile bacteria into six classes for staining purposes:

1. Bacilli which grow like typhoid, such as typhoid and colon. Bacteria resembling typhoid are actively motile bacteria. The material is transferred to a large drop or two of distilled water, previously boiled. A fine platinum loop, about half the usual size, should be used. The finest specimens of bacteria will swim to the outer edges of the water.

2. Bacilli which produce wrinkled or folded growths, such as *Mesentericus fuscus*. In order to get a good preparation from the bacteria which produce wrinkled or folded growths the agar should be streaked in the morning and carefully watched for the first appearance of growth.

3. Bacilli which send out a thin, almost transparent growth over the surface of the agar, such as *Bacillus subtilis* and *Bacillus megatherium*. In order to get a good preparation from the thin, transparent, spreading growth a curved platinum wire is used to collect the bacteria *en masse* and transfers are made to the distilled water with the small loop.

4. Bacilli which produce slime, such as *Bacillus vulgatus* and *Bacillus viscosus*. The slime which collects between the flagella of the slime-producing bacteria can be precipitated by shaking a water suspension with chloroform. A very young growth is used and transfers are made to about 1 c.c. of water until it is made very cloudy. This suspension is then shaken with chloroform and the cover-glass preparation is made from the water above the chloroform.

5. Bacilli which produce pigments, such as *Bacillus prodigiosus* and *Bacillus cyanogenes*. Bacteria which produce pigments soluble in chloroform are treated in the same manner. Those whose pigments are soluble in water and not in chloroform I prepare by holding the cover-glass under the tap after fixing the preparation in the flame previous to adding the mordant.

6. Anaerobic bacteria, such as *Bacillus tetanus*, œdema and symptomatic anthrax, etc. The best results with anaerobic bacteria are obtained as follows: The medium is two per cent. glucose agar in slants and the inoculation is made back of the slant between the agar and the wall of the tube. I slide the needle back of the slant and let it fall forward, I introduce two or three drops of a young bouillon culture and replace the agar. By excluding oxygen and maintaining a blood temperature for thirty-six hours a fine growth is usually obtained.

I prefer the No. 1 round cover-glasses. For removing the grease they are covered with sulphuric acid, which is poured off after they have stood one day, and they are then covered with bichromate of potassium. After several hours this is poured off and they are washed with distilled water and transferred to a jar containing absolute alcohol, where they remain until ready for use. A single cover-glass is removed with clean forceps from the alcohol and dried with clean linen without touching it with the fingers. It is then taken in the forceps and passed several times through the Bunsen flame.

The fixing agent is a mordant and the stain is carbol gentian violet or preferably carbol fuchsine.

Mordant.—2 grams tannic acid; 5 grams cold saturated solution ferrous sulphate (aqueous); 15 c.c. distilled water; 1 c.c. saturated alcoholic solution of fuchsine.

To these ingredients I add a one per cent. solution of sodium hydroxid, from .5 to 1 c.c. After filtering, the mordant should be of a reddish-brown hue, and it must be used within five hours after it is made.

Carbol Fuchsine.—Put about one gram of granulated fuchsine in a bottle and pour over it 25 c.c. of warm alcohol; shake, let stand for several hours, and dilute four or five times with a five per cent. solution of carbolic acid.

A small loop full of the clouded water is transferred to the cover-glass. A spread consisting of several parallel streaks is best. The glass, held by the forceps, preparation side up, is passed down on to the Bunsen flame and instantly removed. The mordant is then poured on, just enough to cover the surface without flowing over the edges. After one half to one minute the mordant is completely washed off under the tap; a small quantity of alcohol is then poured on to the surface and instantly washed off. Then cover the surface with carbol fuchsine or carbol gentian violet, which is allowed to stand on the cover-glass for about one half minute. We then heat it so that steam is given off and, after drying thoroughly, treat with xylol, immediately draw off the xylol with filter paper, drive off what remains with heat and mount in xylol balsam.

A Simple Method of Making Photomicrographs.—The camera is about twice as long as the ordinary 4 x 5 camera, and the photomicrographs are taken with the camera in a horizontal position. It must be steady and the microscope stand should be substantial, with the fine cone adjustment. Much depends upon the objective. I have found none equal to the one-twelfth oil immersion objective and No. 6 compensating eye-piece made by the Spencer Lens Co. The best plates are the isochromatic or orthrochromatic swift plates which are corrected for colors. I have found the acetylene radiant preferable to gas, oil or electric light. The only screen I ever use is green glass. Printing from the negatives on glossy Velox brings out the best detail. The glossy Velox is then ferroplated, which makes a beautiful photograph.

(Complete paper will be published in the *New York Medical Journal;* also in the *Canner and Dried Fruit Packer,* 1905, XX., No. 5, p. 23, with many illustrations.)

Principles of Classification of Bacteria: F. D. Chester, Delaware Agricultural College.

As far as possible morphologic characters should be the primary basis of classification. The generic system of *Migula* is proposed, based upon character of flagellation.

With sporogenous bacteria, character of spores, mode of germination, form of sporangia, and orientation of the cellular elements are useful toxonomically. With the asporogeneous bacteria grouping must be based largely upon physiological characters.

The proposed division of genera into groups is based upon leading characters in the order named: (1) Spore formation, (2) relation to oxygen, (3) liquefaction of gelatin, (4) fermentation of lactose, (5) fermentation of dextrose, (6) fermentation of saccharose, (7) reduction of nitrates, and (8) chromogenesis.

Any combination of the above-named characters gives a character complex which can be best represented by a series of digits. Each digit represents a character in order of value. When the character covered by a digit is either positive or negative two numbers only are necessary, *i. e.*, 1 and 2, 1 signifying positive and 2 negative. Thus spore formation and non-spore formation by 1 and 2 in the hundreds place; aerobic-facultative anaerobic and anaerobic by 1 and 2 in the tens place, and liquefaction and non-liquefaction of gelatin in the units place represented by 1 and 2. In the tenths, hundredths and thousandths place of decimals three numbers are used, in which 1 represents acid with gas and 2 acid without gas, while 3 no acid from dextrose, lactose and saccharose respectively, 1 and 2 in the next place indicate reduction and non-reduction of nitrates, and in the next place numbers from 0 to 8 indicate the absence or the presence of chromogenesis in the order of the occurrence of the colors in the spectrum, namely, 0, non-chromogenic; 1, fluorescence; 2, violet; 3, blue; 4, green; 5, yellow; 6, orange; 7, red; 8, brown; on this basis the number for *B. coli* is 212.11110, for *B. enteritidis* 212.13310.

A Revision of the Coccaceæ: C.-E. A. Winslow and Anne F. Rogers, Massachusetts Institute of Technology.

Since the swamping of minor differences by sexual reproduction is absent among bacteria, every inheritable variation is maintained, and instead of true species we find an infinite series of minutely differing but constant races. The only practical method of handling and systematizing these is to establish certain fairly distinct groups or types about which the lesser individual variations may be grouped. The larger number of published descriptions of species among the cocci are based either on variable or on isolated and unimportant characters. The authors find that 445 described species may be condensed to 31. These are grouped under two subfamilies and five genera which mark transition stages between strictly parasitic pairs of cells like *D. Weichselbaumii* and strictly saprophytic organisms in large vegetative masses like *Ascococcus mesenteroides*. The principal groups are defined as follows:

FAMILY COCCACEÆ.

Vegetative cells spherical.

Subfamily I. Paracoccaceæ (new subfamily).

Parasites (thriving only or best on or in the animal body). Thrive well under anaerobic conditions. Many forms fail to grow on artificial media, none produces abundant surface growth. Planes of fission generally parallel producing pairs or short or long chains.

Genus 1. *Diplococcus* (Weichselbaum).

Strict parasites. Not growing or growing very poorly, on artificial media. Cells normally in pairs, surrounded by a capsule.

Genus 2. *Streptococcus* (Billroth).

Parasites. Cells normally in short or long chains (under unfavorable cultural conditions, sometimes in pairs and small groups, never in large groups or packets). On agar streak, effused translucent growth often with isolated colonies. In stab culture, little surface growth. Ferment sugars with formation of acid.

Subfamily II. Metacoccaceæ (new subfamily).

Facultative parasites or saprophytes. Thrive best under aerobic conditions. Grow well on artificial media, producing abundant surface growths. Planes of fission often at right angles; cells aggregated in groups, packets or zooglea masses.

Genus 3. *Micrococcus* (Hallier) Cohn.

Facultative parasites or saprophytes. Cells in plates or irregular masses (never in long chains or packets). Acid production variable.

Genus 4. *Sarcina* (Goodsir).

Saphrophytes or facultative parasites. Division under favorable conditions, in three planes, producing regular packets. Generally fail to produce acid by fermentation of sugars.

Genus 5. *Ascococcus* (Cohn).

Generally saphrophytic cells imbedded in large irregularly lobed masses of zooglea. In presence of carbohydrates usually form acid.

Full paper (preliminary) to be published in Science.

Diagnostic Value of the Red Color which Develops on the Addition of Caustic Soda to Solutions of Glucose after Fermentation: Wm. R. Copeland and Perkins Boynton, Columbus, Ohio.

Certain members of the colon group of bacteria produce a substance in glucose solutions which, on the addition of caustic soda (NaOH), forms a brick-red color if the alkali is kept in contact with the fermented bouillon for twenty-four hours.

The glucose solution used in making this test contains:

Meat extract from fresh round beef steak	1,000 c.c.
Peptone—Witte's best white, dry......	10 gms.
Table salt	5 gms.
Anhydrous glucose	10 gms.
Reaction (referred to phenol-phthalein) .	1% acid.

The caustic soda used contains 20 grams of the best grade of NaOH in sticks dissolved in 1,000 c.c. water.

The fermentation is carried on by the bacteria for a period of 48 hours at a temperature of 37° C. +. The bacillus which brings about the formation of the red color resembles the *Bacillus cloacea* of Jordan and the *Bacillus Zea* of Moore.

The bacterium described by Dr. Theobald Smith as the typical '*Bacillus coli communis*' forms reactions which differ markedly in every instance from the reactions produced by *B. cloaceæ*. Therefore, as the colon bacillus never produces the red color in glucose solutions and as *B. cloaceæ* does, the appearance of a strong brick red color in a glucose fermentation tube, to which a two per cent. NaOH solution has been added and allowed to digest for 24 hours, may be taken as evidence that the bacteria in the Smith tube are *B. cloaceæ* and are not *B. coli communis*.

I., *The Value of the Widal Reaction for the Diagnosis of Hog Cholera.* II., *The Production of Agglutinins for Hog Cholera Bacilli in Swine:* Chas T. McClintock, Chas. M. Boxmeyer and J. J. Siffer, Detroit, Mich.

1. The serum of normal hogs agglutinates strains of ordinary hog cholera bacilli in dilutions occasionally as high as 1–250. For this reason we consider a reaction in a dilution of less than 1–300 without diagnostic value.

2. The bacillus of swine dysentery is not agglutinated by normal blood in such high dilutions.

3. The Widal reaction is of no value for the diagnosis of hog cholera, as the disease is at present defined.

4. The presence of a positive reaction does, however, indicate an infection with cholera bacilli.

5. There are occasional instances of both natural and artificial infection in which no increase of the agglutinins for hog cholera over those normally present can be demonstrated.

6. The maximum amount of agglutinin develops in a hog's blood within six or seven days after a single inoculation with hog cholera vaccine.

7. Hogs react to intraperitoneal injec-

tions of hog cholera vaccines, usually with the production of large quantities of agglutinins, the amount of the vaccine bearing no relation to the amount of agglutinin produced.

(Complete paper will be published in the *Journal of Infectious Diseases.*)

A Method for Inoculating Animals with Precise Amounts: M. J. Rosenau, Hygienic Laboratory, U. S. Public Health and Marine Hospital Service.

The author gives an original method for inoculating animals with precise amounts. With the ordinary methods used in most laboratories there is an unavoidable loss resulting in an error of from one to eight per cent. If the solution is measured into a graduate and then drawn up into a syringe a certain quantity remains in the graduate, and the entire contents can not be expelled from the ordinary piston syringe. In a number of weighings this loss was determined to average about .04 c.c. in using 4 c.c. of fluid, that is, about one per cent. of the amount used.

The new method consists of a battery of syringe barrels, one for each animal. The amount of fluid is measured into the syringe barrel directly, thereby totally eliminating the loss in the graduate. The entire contents of the syringe is expelled by means of a rubber bulb and any fluid remaining behind is washed out with a neutral and sterile solution. The syringe itself is a modification of the Koch syringe.

In working with different weights of solids, the solution may be made in the barrel of the syringe, so that the method is applicable to any sort of work where it is important to inoculate animals with precise amounts.

The method is especially useful in standardizing diphtheria antitoxin, in determining the strength of toxins and in certain lines of physiological chemistry where the greatest precision is essential. The battery of syringes is held in a specially designed rack which has many useful points.

(Complete description in U. S. Public Health and Marine Hospital Service, Hygienic Laboratory Bulletin, No. 19.)

A Method for Using Capacity Pipettes: M. J. Rosenau, Hygienic Laboratory, U. S. Public Health and Marine Hospital Service.

The pipette is held in a retort stand and has a rubber bulb attached to its upper or suction end. By means of a thumb-screw the fluid may be drawn up into the pipette to a point slightly above the mark. The outside of the pipette is then wiped with a piece of sterile gauze, and by applying a similar piece of gauze to the tip of the pipette the fluid may be drawn down so that the meniscus rests exactly on the line. The contents of the pipette may then be washed in and out by means of the rubber bulb into the syringe or vessel that is to contain it.

A Method for Using Delivery Pipettes. M. J. Rosenau, Hygienic Laboratory, U. S. Public Health and Marine Hospital Service.

This is similar to the method described for using capacity pipettes and has a similar rubber bulb attached to the upper end of the pipette; but in addition, attached to a glass *T*, is a valve consisting of a piece of rubber tubing controlled by a Mohr's pinchcock. The fluid is drawn up above the mark, and is nursed down by means of a piece of sterile gauze, as related above in using capacity pipettes. By opening the pinchcock the contents of the pipette may be delivered into any vessel desired. The method is both quick and accurate.

Exhibition of Cultures on Starch Jelly and on Silicate Jelly: Erwin F. Smith, U. S. Department of Agriculture.

These media were recommended for differential purposes. The preparation of the first is given in Proceedings Boston (1898) Meeting of the American Association for the Advancement of Science; that of the second will be given in the first volume of the writer's monograph on 'Bacterial Diseases of Plants' (Carnegie Institution). It is easy by this method to prepare a silicate jelly free from glycerine and at the same time having a moist, smooth (untorn) surface, well adapted to the growth of many bacteria and not at all to that of others. The nutrient salts used were those of Fermi's solution.

Introductory Remarks on Morphology of Bacteria: H. W. Hill, Boston Board of Health Laboratory.

The writer points out the chaotic state of the evidence relating to morphology, and the difficulty of determining what is the normal morphology of bacteria, supports the acceptance of artificial standards for temporary purposes and urges very much more detailed attention to every phase of morphology than has as yet generally been given to it, as a basis for a more exact abstract science of morphology. He recommends also more attention to the direct continuous microscopic examination of bacteria during the processes of fission, spore formation, spore germination, etc.

A Peculiar Spirillum Showing Rosette Formation: Mabel Jones, University of Chicago.

The organism in question was isolated in October, 1904, from the Chicago water supply and also from Chicago sewage.

The organism is a short, rather plump 'comma,' with pointed ends, frequently growing out into straight or spiral filaments or forming 's'-shaped figures and semicircles.

There is a singular tendency towards definite rosette formation. This grouping is shown in cover-slip films and is apparently effected by a uniform grouping of the descendants of a single organism, and is in no sense an agglutinative phenomenon. The flagella, pointing towards the center of the rosette, stain by ordinary stains and add to the singularity of the picture presented by these chrysanthemum-like clusters.

Glucose-agar under anaerobic conditions seems to favor the formation of rosettes.

(Will probably be published in the *Centralbl. f. Bakteriol.*, etc.)

Notes on the Chemical Constitution of Bacillus Tuberculosis: M. Dorset and J. A. Emery, U. S. Bureau of Animal Industry.

The authors report having found in the bodies of tubercle bacilli two classes of substances soluble in water. One portion of the ether extract is not saponifiable by the usual methods and possesses many of the characteristics belonging to the higher alcohols of the aliphatic series. This alcohol is completely acid-fast and it seems probable that the characteristic staining properties of tubercle bacilli are due to its presence in them. The second portion of the ether extract is easily saponifiable and consists of several different substances the nature of which has not yet been determined.

(To be published in Annual Report, Bureau of Animal Industry, 1904.)

The Metabolism of Chromogenic Bacteria: M. X. Sullivan, Brown University.

I. The biochemical study of bacteria is carried on best in simple, synthetic culture media.

II. Some bacteria show little power to grow upon synthetic media; it is probable that the power to grow upon such media can be developed; thus we may accommodate the medium to the organism or adapt the organism to the medium.

III. Many bacteria may be grown readily upon synthetic culture media.

IV. From those readily growing on such media I have chosen for study *B. pyocyaneus, B. prodigiosus, B. ruber balticus, B. rosaceus, B. metalloides, B. violaceus, B. janthinus.*

V. These bacteria may be grown with or without pigment formation.

VI. Whether producing pigment or not, these chromogenic bacteria give the same metabolic products, as far as these have been analyzed, *e. g.*, acids, ammonia, alcohol, benzol derivatives and albuminous bodies.

VII. The metabolic products are as follows: *B. prodigiosus,* aldehydes, formic, acetic and citric acids; albumin. *B. rosaceus, B. metalloides,* formic and acetic acids; albumin. *B. ruber balticus,* formic acid; albumin. *B. violaceus,* aldehydes, formic acid; albumin. *B. janthinus,* formic acid; albumin. *B. pyocyaneus,* aldehydes, formic acid, mercaptan, H_2S; albumin.

The Intracellular Toxins: V. C. Vaughan, University of Michigan.

Bacterial cellular substance is obtained in large amount by growth on the large tanks which have been used for some years in the author's laboratory. After fourteen days of growth, the cell substance is removed, washed with water and absolute alcohol, then thoroughly extracted with ether, dried, pulverized, weighed and heated in a reflux condenser with sodium alcoholate. This splits the cell substance into a toxic and a non-toxic portion. The toxic part is soluble in absolute alcohol, while the non-toxic is insoluble in this reagent. The alcoholic solution is neutralized with hydrochloric acid and the sodium chloride, which forms, is removed by filtration. The filtrate is precipitated with an alcoholic solution of platinum chloride which precipitates the toxin. The platinum precipitate is suspended in absolute alcohol and decomposed with hydrogen sulphide, after which the alcoholic solution of the toxin is evaporated in vacuo. Animals have been immunized with this toxin both to the living germ and to the toxin itself. Animals treated with non-fatal and gradually increased doses of the toxin acquire immunity and furnish a blood serum which is both antitoxic and bacteriolytic. The toxin gives all the proteid color reactions. It is apparently an acid and combines with organic bases.

The non-toxic portion of the germ substance, or that which is insoluble in alcohol, is soluble in water, and with aqueous solutions of this substance bacteriolytic immunity is easily induced. Toxins have been obtained from colon, typhoid, and anthrax bacilli and animals have been immunized to the first two.

(To be published in the *Journal of the American Medical Association.*)

Relation of the Index of Alkalinity to the Production of Diphtheria Toxin: A. P. Hitchens, Glenolden, Pa.

A study of the reaction of bouillon before and after sterilization shows that in media containing carbohydrate the rise in acidity after sterilization varies according to the temperature of the sterilizer. This is most important in the production of diphtheria toxin. Bouillon prepared according to the method of Smith, and sterilized in the autoclave, showed after sterilization varying indices of alkalinity. The reaction after sterilization of sugar-free bouillon is very uniform. And as the reaction of bouillon for the production of diphtheria toxin must be very exact, it is advantageous to add the dextrose after sterilization. The meat juice is neutralized to litmus, planted with the colon bacillus and incubated over night to destroy the muscle sugar. The bouillon is made from this in the ordinary way, two per cent. of Witte's peptone being added. It is dispensed into Fernbach flasks, one liter in each, and sterilized in the autoclave. Little attention need be paid to the temperature, it may vary anywhere from 115° to 120°, 0.2 per cent. of dextrose is added after sterilization. The cultures are incubated six days at 35°–36° C. The reaction of the bouillon before sterilization is made +.45, so that after sterilization it may be +.75. Toxin made by this method has been very uniform, rarely being below .005 c.c. for a 250-gram guinea-pig.

(To be published in the *Journal of Medical Research.*)

On the Antagonism of Bacteria and their Products towards Other Bacteria: L. F. Rettger, Sheffield Scientific School, Yale University.

Considerable attention has been given in recent years to the influence that one microorganism is capable of exerting on the life and growth of another. We learn, on the one hand, that certain bacteria profit by association. Again, there are numerous instances in which the presence of one organism, or its products, is inimical to the development of another. For example, the *pyocyaneus* bacillus has been found to act in a very antagonistic manner toward the anthrax bacillus. And not only is this true of the living bacilli themselves, but also of certain of their products. Emmerich and Loew claim to have succeeded in immunizing rabbits against anthrax by the use of their so-called 'pyocyanase,' which they prepared from old bouillon cultures of *B. pyocyaneus.*

In a study of the chemical and physiological properties of *B. prodigiosus* and its products, I observed, among other things, that sterile cultures or preparations of the *prodigiosus* bacillus exerted a strong protective action against experimental anthrax when injected in small quantities under the skin or into the peritoneal cavity of guinea-pigs. Of nine experiments that were carried out in full, seven yielded very positive results. In the eighth the animal died as a result of over-dosing with the *prodigiosus* material; and in the ninth, both the *prodigiosus* and control animal lived, owing to the small number of anthrax bacilli injected (47). In six of the seven experiments that gave positive results, the life of the guinea-pig was prolonged 14, 24, 25, 26 and 72 hours, respectively; while in the seventh the animal entirely recovered.

The *prodigiosus* material used for injection was prepared from potato cultures of the *prodigiosus* bacillus. The cultures were scraped and allowed to stand under chloroform for twenty-four hours. After drying in an exhaust desiccator, the mass was ground into a fine powder. Definite quantities of this '*prodigiosus* powder' (0.05 to 0.1 gram) were mixed with ten cubic centimeters of sterile physiological salt solution, and after filtration through loose absorbent cotton definite amounts of the suspension were injected, usually under the skin of the abdomen and in rather close proximity to the site of the anthrax injection.

For inoculation with anthrax, young agar cultures were employed. The bacilli were suspended in physiological salt solution, and their number was approximately determined by the use of agar plates. The inoculation with anthrax was made under the skin of the abdomen. In all the experiments control animals were employed.

Although sterile *prodigiosus* powder exerts such a pronounced protective action against anthrax, there remains at present one serious objection to its employment in practical immunization work. It exerts such a degree of toxic action, when injected, that only very small quantities can be used without serious consequence to the animals. Attempts thus far made to destroy the toxic properties of the *prodigiosus* products without lessening their protective action have not given the desired results.

Associative Action of Bacteria on the Souring of Milk: C. E. Marshall, Michigan Agricultural College.

The author, working with cultures of associated bacteria, consisting of *B. acidi lactici,* and a bacillus obtained from milk and not yet described, possessing marked proteolytic action in its growth upon milk, and producing alkaline reaction, decidedly marked in old cultures, has been able to demonstrate that loppering is hastened by the presence of this proteolytic germ over that of the lactic acid germ, by as many as ninety-six hours at times, temperature 20° C.; that the acidity rises high above that of the lactic germ; that these changes may be noted by the naked eye appearances of the cultures; and, further, that the lactic acid germ develops much more rapidly when associated with these proteolytic germs than when existing in pure cultures. He has also found that the products produced by the proteolytic germ are stable and that they may exert the same influence as the presence of the living germ. Analyses of cultures at various ages indicate that the products influencing the growth of the lactic acid germ are either amido or ammonia compounds. Synthetic cultural media have been attempted, but without satisfactory results thus far.

It may also be said that peculiar curdling effects have been obtained with fresh milk from the cow and of various ages thereafter. This may account for certain peculiar cultural results secured in cultivating germs in various samples of milk.

The description of the proteolytic germ and the detailed work will be published in *Centralbl. f. Bakteriol,* etc. (Zweite Abteilung), at no distant date.

Bacterium truttæ: A Pathogen to Trout: M. C. Marsh, U. S. Bureau of Fisheries.

An organism which causes serious epidemics among domesticated brook trout and is not pathogenic to warm-blooded animals. The characters of chief interest are its pleomorphism, color production, apparent acquirement of motility on media, and low death point.

(Complete paper in Bulletin of U. S. Fish Commission, 1902, p. 411.)

A Germ-proof Filter: F. P. Gorham, Brown University.

The filter consists of a porcelain tube upon which a layer of aluminum hydroxide, bound together by mineral wool, is deposited. The effluent is of excellent quality chemically, all algal odor is removed, is germ free after running continuously for over a year, and the rapidity of flow is some seven times that of the uncoated tube at the start, and double the speed of flow of an uncoated tube after a continuous run of fourteen days.

The filter is the invention of Mr. James G. Woolworth, Providence, R. I.

The Bacteria Encountered in Suppurations: D. H. Bergey, University of Pennsylvania.

In the examination of pus by the students in the laboratory it has been my experience that frequently bacteria are encountered which are not ordinarily classed among the pyogenic organisms. The frequency with which certain of these organisms were encountered and the fact that some of these organisms had previously been encountered in suppurating wounds: that organisms of a similar character had been encountered in catarrhal mammitis in cows; moreover, the fact that similar organisms have been encountered in abscesses occurring spontaneously in mice, led to the opinion that they might possibly have a more intimate connection with suppuration under certain conditions than had been supposed. For this reason specimens of pus were obtained in the hospital from thirty cases in the surgical wards. Aside from the ordinary pyogenic organisms—as the staphylococci, streptococci and *Bacillus pyocyaneus*—bacillus coli was encountered several times; an organism belonging to the group of pseudo-diphtheria bacilli and also an organism belonging to the proteus group were encountered several times, so that it appeared probable that they were not accidental contaminations of the pus. The extent to which these organisms are capable of producing suppurations when acting alone has not been fully worked out. Neither has their effect upon the processes of the pyogenic organisms been studied with sufficient detail to make positive statements. The frequency, however, with which these organisms were encountered in the conditions studied seemed to warrant a preliminary report upon the studies so far made.

The Bacteriology of Some Railroad Water Supplies: L. H. PAMMEL, Iowa College of Agriculture.

The author gave an account of an examination of three water supplies of railroads. Generally speaking, the newer wells along the line of the C. & N. W. R. R. are deep wells, 125–150 feet deep. In some cases the Iowa railroads depend on city water supplies. It is interesting to note that in the few cases where the city water supplies have been used, *B. coli communis* has been found. Several new species have been found, among them a red *Planosarcina.* The average number of bacteria varies from 40–150, though in some cases somewhat higher. Best results have been obtained with litmus lactose agar; the gelatine has been unsatisfactory.

Changes in the Bacterial Content of Water in Passing Through a Distributing Reservoir: B. G. PHILBRICK, Metropolitan Water and Sewage Board, Boston, Mass.

The data reported represent routine weekly analysis, covering a period of ten years, of the influent and effluent streams of Chestnut Hill Reservoir. The number of bacteria in the influent is small, only 220 on the average, and is not markedly affected by rainfall, since the water experiences considerable storage and sedimentation before it reaches that point. The general average of bacteria in the effluent is 179, 82 per cent. of the influent figure, but the ratio for different years varies from 50 per cent. to 123 per cent. Considering the monthly average for ten years, an increase during passage through the reservoir is noted at the time of the spring and fall overturns bringing the ratio of effluent to influent up to 123 per cent. for April and 134 per cent. for September.

During the winter the ratio decreases from 96 per cent. in December to 71 per cent. in March and after the spring overturn it rises from 69 per cent. to 95 per cent. in August. It appears that in a reservoir receiving water fairly low in bacteria the growth at the bottom of the reservoir itself and the mixture of its various layers, are the main factors in determining the effluent count.

The New Bacteriological Laboratory of the Boston Board of Health. B. R. RICKARDS.

A detailed description of the new laboratory including several special features such as (1) chute leading to an incubator to receive cultures sent after the laboratory is closed, (2) open trough system of plumbing, (3) combination draining board and tray for the transportation of glassware from one part of the laboratory to another,

(4) Portland cement benchtops under incubators and on other benches where gas flames are in constant use.

The Construction of a Thermostat-room: N. MacL. Harris, University of Chicago.

Every well-appointed laboratory engaged in teaching large classes should have an incubator room. The costly copper thermostat is entirely inadequate. The thermostat in this case was built for the pathological laboratory of the Johns Hopkins University and was modeled somewhat after one seen in Kjoebenhavn, Denmark, and one in the Institute for Infectious Diseases in Berlin.

The cost of this room was one hundred and twenty dollars exclusive of the thermoregulator and Koch safety burner, a sum often exceeded by the larger sizes of the ordinary copper-built apparatus on the market.

A complete description of this room will soon appear in the *Journal of Experimental Medicine* or in the *Centralblatt für Bakteriologie.*

The Utilization of Leaky Incubators: C. F. Dawson, University of Florida.

The leaky incubator is not an uncommon piece of apparatus in the older laboratories. Owing to the difficulty with which they are kept in repair when once they have begun to go to pieces, it is doubtful economy to attempt, in most cases, to keep them in commission.

As in the case of old and tried friends, we dislike to part with them. Although it is not the possession of such an incubator, at present, that has prompted this short note, a long laboratory experience has shown me that many fine and expensive old ovens have been consigned to the worn-out apparatus pile, because of their leaky propensities.

The writer is at present using one of Bausch and Lomb's finest incubators, without the usual water-jacket, and has never seen a more perfectly regulated apparatus. In this case the mercury regulator is, of course, passed through one of the tubulatures into the culture chamber.

We thus directly regulate the amount of heat in the place where it is wanted, and not through the medium of heated water. Such an apparatus is easily and quickly regulated. There are no long periods of over-heating or under-heating, as is the case when we have a large volume of water to heat up or to cool down.

Some might object to the rapid cooling when the door is opened; but this is quickly counteracted by an almost immediate return to the temperature for which the regulator is set, when the door is closed again.

Were this system adopted the expensively constructed incubator would be a thing of the past, as cheaper materials, such as wood and tin, could be employed in their manufacture.

I., *Demonstration of an Efficient Thermo-Regulator:* A. Robin, Wilmington Water Department Laboratory.

The thermostat consists of an ordinary automatic gas burner, such as is sold in hardware stores, connected with a regulator made on the same principle as the minimum and maximum thermometer with three electrodes, one reaching 38° C., the other 37° C., and a third connected at the bend of the U tube. The spring wires opening and closing the valve in the gas burner are slightly bent so as to permit a small amount of gas to pass, thus doing away with the spark coil generally used to light the burner. Two open-cell constant-current batteries supply the necessary current. When the temperature in the incubator reaches 38° C. the mercury rises, making a contact with the electrode on the dark side, and the flame is automatically turned down. When the temperature falls to 37° C., the mercury column on the left side makes the contact, turning on the flame. Thus, the temperature is regulated within one degree. Instead of the mercury regulator, one made of thin brass and hard rubber strips securely fastened together and arranged between two contact points, may be used. The metallic thermo-regulator may be bought in the open market.

II., *A Simple Method of Making Anaerobic Plates.*

The medium consists of lactose agar, 1.2 per cent., which is plated in the usual way and placed on a nivellator. When thoroughly solidified, 7 c.c. of an agar jelly made of 1.2 per cent. agar in distilled water, are poured on each plate making a closely adhering transparent film. This practically accomplishes what the mica plate does, with the advantage, however, that the agar film adheres more closely, covers the medium more satisfactorily and is readily applied.

Laboratory Expedients. S. DEM. GAGE, Lawrence Experiment Station.

In the modern public health laboratory, a large amount of routine work of considerable detail is often required, and while an increase in the necessary funds is often not forthcoming, constant pressure is usually exerted upon the head of the laboratory to increase the scope of the work and the output of the working force. Under these conditions it is often a problem for the working bacteriologist to satisfy all requirements and at the same time to be able to carry on experimental work. The solution of this problem usually lies in systematizing the work and in the use of labor-saving devices whereby the time consumed in routine work may be shortened. It is the purpose of the author in the present paper to describe some of the laboratory expedients at the Lawrence Experiment Station as regards both the system in vogue and the labor-saving devices in use there, under the following headings: (1) Apparatus should stand rough handling, (2) color system and use of tubes of different dimensions for identifying media, (3) dilution bottle filler, (4) apparatus for holding inoculating needles during sterilization, (5) improvised apparatus, (6) loose sheet system of keeping records, (7) methods of keeping track of samples and experiments, (8) numerical systems.

A Method for the Direct Microscopical Enumeration of Bacteria: C.-E. A. WINSLOW, Massachusetts Institute of Technology.

One twentieth of a cubic centimeter of the liquid to be examined is discharged from a sterile graduated pipette on a carefully cleaned cover glass of known diameter. This is dried in the air, fixed and stained in the usual way with carbol-fuchsin. The bacteria in ten square fields, 0.1 mm. on a side, are counted by the aid of a Sedgwick-Rafter micrometer and the total number determined by multiplication. The method is rapid, easy and accurate, but applicable only to fluids like sewage which contain 25,000 or more bacteria per cubic centimeter.

The results obtained when pure cultures are examined check very closely with those of the plate method even when the number of bacteria present is decreasing very materially. Thus it appears that dead bodies of bacteria are quickly removed in the presence of other living germs and introduce no serious error. On the other hand, sewage and sewage effluents show numbers 10 to 100 times as high as the plate count, due mainly to the inclusion of forms which do not grow on ordinary media.

Full paper to be printed in the *Journal of Infectious Diseases* (with G. E. Willcomb).

A Simple Method for Determining the Ability of Bacteria to Ferment Different Sugars: L. A. Rogers, U. S. Bureau of Animal Industry.

In volume VII., page 241, of the *Cent. f. Bakteriologie*, 2d Abt., Linder describes a simple method for the determination of the ability of yeasts to ferment different sugars. This method consists essentially in filling the cavity of a concave glass with sterile water, inoculating with yeast, adding a very small amount of the sugar and sealing on a cover glass. The fermentation of the sugar is indicated by the appearance of bubbles under the cover-glass.

With a few minor variations this method may be used with bacteria. For this purpose litmus is added to sugar-free bouillon until it has a deep blue color. The sugars to be tested are made to a syrup and sterilized in small phials. The slides and cover-glasses may be sterilized in Petri dishes. A single tube of the litmus bouillon is inoculated with the organism to be tested and incubated for a few hours. A ring of vaseline is run around the cavity of the slide while it is warm and the cavity completely filled with the culture. A loopful of the sugar solution is added to each and a cover-glass placed carefully over the cavity and pressed onto the vaseline without admitting any air bubbles. The surplus media may be taken up with a filter paper. After a period of incubation the fermentation of the different sugars will be indicated either by the appearance of gas bubbles or by the reddening of the litmus, or by both.

The advantages of this method over the ordinary fermentation tubes are the rapidity with which the fermentation of a large number of sugars may be determined and the very slight expense required for the sugars.

With the fermentation tube the expense of determining the fermentation of the rarer sugars is so great that the fermentative ability of an organism is ordinarily given for three or four sugars.

With the culture-slide method the amount of sugar used is so slight that a small amount may be kept always ready for use, thus obviating the necessity of keeping on hand a large number of different kinds of media. The danger of contamination may seem a serious obstacle, but with ordinary care it is very slight and may be reduced to a minimum by the use of a case for the protection of the slides. A convenient arrangement for this purpose is a box with glass sides made after the pattern of a balance case, with a sliding door so that the slides may be prepared with only the forearms inside the case.

A Simple Method of Cultivating Anaerobic Bacteria: B. R. Rickards, Boston Board of Health Laboratory.

With solid media, an ordinary inoculated slant or stab tube immersed mouth down in a receptacle containing alkaline pyrogallic acid is used. Plates are made by using an Erlenmeyer flask instead of a Petri dish, inverting and immersing as with tubes.

For liquid media, the Lawrence form of fermentation tube is used, the liquid being allowed to run into the closed arm before inverting and immersing the mouth of the tube in the pyrogallic acid.

(*Cent. f. Bakt.*, Orig. XXXVI., s. 557.)

New Apparatus: H. W. Hill, Boston Board of Health Laboratory.

Porous Top for Petri Dishes.—The porous top is an exact duplication, in porous flower-pot earthenware, of the ordinary glass top, and is used in every way similarly to, and as a substitute for, the glass top, except that it is best not to wash it between uses.

Its function is to absorb the excess moisture which, when glass tops are used, results in 'spreaders.'

In use, the percentage of 'spread' plates found in routine plating work of milk on agar at 37° C. in a saturated atmosphere has been reduced from 38 per cent. with glass tops (plates inverted) to 3 per cent. with porous tops (plates not inverted).

(*Journal of Medical Research*, 1904, XIII., 93.)

Staining Bacterial Fields under Microscopic Observation.—This is a mechanical device for applying stains, decolorizers, mordants, etc., directly and readily to the lower smeared surface of a cover-slip, in such a manner as to stain, decolorize or mordant, successively, in any order, a selected microscopic field, while the same is under observation, with provision also for a water flush to remove the surplus solutions applied. Particularly useful for Gram's stain, comparison of different stains, etc.

Method for Obtaining Smears for Flagella Staining.—The organism to be obtained is grown in broth, on the principle that in broth flagella are better developed than on the solid media usually recommended. To remove the broth from the organisms, repeated centrifugalization, decantation and addition of distilled water or normal salt solution is used. Numerous experiments show that the centrifugalization does not denude the bacilli of flagella to any extent.

(*Journal of Medical Research*, 1904, XIII., 97.)

A Method of Obtaining a High Percentage of Serum from Blood: C. W. Lincoln, Glenolden, Pa.

In this method the blood is drawn into a tall narrow bottle without shoulders. A drip flask is made of a narrow glass percolater of the same caliber as the blood bottle, resting on a wide mouth quart bottle, the two being bound together by a broad band of paper tied firmly to each. Into the bottom of the percolator is dropped an inverted cone of coiled nickeled wire, the upturned base of which shows a flat surface of coiled wire with interspaces of not over one fourth of an inch. A paper cap is put on the percolator and the whole sterilized together. When clotting has taken place and all the serum has been drawn or poured off, the clot is gently slid from the blood bottle into the drip flask, both being held nearly horizontally. The two vessels being of the same caliber, the clot is but slightly injured and rests on the wire cone on its tough buffy coat, so that the serum that drips is not at all reddened after the drip flask has stood in a refrigerator for 24 hours. By this method 46 per cent. of serum may be obtained and if the pouring is done in a comparatively dust-free room no contamination occurs.

Note on the Occurrence in the Natural Waters of Eastern Massachusetts of Bacteria Simulating Sewage Forms: E. G. Smith, Massachusetts Institute of Technology.

The author has observed in studying the bacteria of natural waters that species occur with considerable frequency which exhibit to a marked degree the reactions of colon bacilli, and he points out that these organisms may sometimes lead to erroneous conclusions as to the sanitary quality of a water.

Examination of 100 samples of water taken from sources 'presumably polluted.' The samples are from springs and brooks, public water supplies, pools and other sources where rapid personal inspection of the surroundings showed them not liable to pollution. These, for the most part, are through the eastern section of Massachusetts. Most of the samples contained forms liquefying gelatin so rapidly as to make the counting of numbers impossible after forty-eight hours at 20° C. The most striking fact is the prevalence in these open waters of the development of red colonies on lactose-litmus-agar, sixty of the samples showing distinct red colonies either on the surface or imbedded in the medium. All typical growths have been differentiated and found to give more or less fully the colon reactions. Open brooks such as would be used for any impounding reservoir give often the most questionable data when rigidly interpreted; for example, from a small brook flowing through woodland and abandoned pasture with no tillage land above gave as high as six red colonies, differentiating out as modified colon forms, to the cubic centimeter. In but two cases, however, has the writer been able to isolate the streptococci—once in an open brook near Whitman, Mass., and once near the mouth of Elmer's Brook in South Hadley, a famous trout stream. Neither of these are polluted waters as we understand them, but the above determinations should not be accepted as final until further study of the area may have removed all possibility of contamination from animals. So far as we have gone in this inquiry the statements of Houston appear to be justified. It is of some importance, therefore, that careful inquiry as to the occurrence of the streptococci forms in nature be continued. Any considerable pollution of a natural water by fecal material will show these forms, which are readily distinguishable on the litmus-lactose-agar plate; and if continued examinations may show them not to be present in normal country waters their significance from the sanitary point of view is evident.

The Steam Still: F. C. Harrison and B. Barlow, Ontario Agricultural College.

Some Large but Inexpensive Incubators for Teaching and Working Laboratories: S. C. Prescott, Massachusetts Institute of Technology.

Some Experiences with Test-tubes: H. A. Harding, Experiment Station, Geneva, N. Y.

Frederic P. Gorham,
Secretary.

Brown University,
Providence, R. I.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

The eighth annual meeting of this society was held, in conjunction with the meetings of the American Association for the Advancement of Science and the affiliated societies, at the University of Pennsylvania, Philadelphia, December 28–30, 1904, under the presidency of Dr. George T. Moore. The meeting was large in point of numbers, and in all ways successful. The following officers were elected for the ensuing year:

President—Professor E. C. Jeffrey, of Harvard University.

Vice-President—Dr. C. O. Townsend, of the United States Department of Agriculture.

Secretary-Treasurer—Professor W. F. Ganong, of Smith College.

The following new members were elected: Dr. G. P. Burns, of the University of Michigan; Dr. A. L. Dean, of Yale University; and Messrs. C. F. Kellerman, W. M. Scott and D. B. Swingle, of the United States Department of Agriculture. As its delegate to the International Botanical Congress in June the society elected Professor Farlow, and made provision for an alternate if he can not be present. The society accepted the principles, recommended by its committee of conference (published in this journal, XXI., 197), upon which it will merge, along with the Botanical Society of America and the American Mycological Society, into a national Botanical Society. A committee, consisting of the present and retiring presidents and the secretary, was appointed to cooperate with committees of the other societies to take further steps towards bringing the union into effect. The society expressed by special vote its great appreciation of the hospitality of the university during the meeting, and its sincere thanks therefor.

The address of the president dealt with 'Applied Botany and its Dependence upon Scientific Research.' It has been printed in full in this journal. The papers, of which abstracts follow, were with but two exceptions presented in full and discussed, and include all that were admitted to the program. The abstracts are in every case by the authors.

Causes Inducing the Habit of Growth of Asparagus plumosus: Professor F. C. NEWCOMBE, University of Michigan.

The common asparagus fern so-called is grown as a dwarf or as a climbing plant, according to the space afforded the roots. It bears no functional leaves, but the work of carbon assimilation is performed by the branches, the ultimate ones of which occur in little tufts of needles. The remarkable thing about the habit of growth of the plant is its change from a radial structure to a dorsiventral, and a rather sudden change in its response to environment.

The young main stems of the plant are at first erect, positively heliotropic and negatively geotropic. At the time the secondary branches begin to grow out, however, in the dwarf plants the upper part of the main stem, or in the climbing plants the oldest lateral branch, assumes the horizontal position, and all members which subsequently grow from this horizontal piece take the horizontal position. This change to the horizontal position is made in the course of three to four days. It may be considered as due to the plant becoming diaheliotropic, or diageotropic, or the position may be the resultant of the antagonistic action of negative heliotropism and negative geotropism.

Experiments have shown that the horizontal position is the result of the plant changing its behavior towards gravitation. The stem changes from negative geotropism to diageotropism.

Further Observations on the Nature of Color in Plants: Dr. HENRY KRÆMER, Philadelphia College of Pharmacy.

1. According to the author's studies, plant color substances may be divided into two classes: (*a*) Organized color principles, which are characterized by being an organic part of the plastid body, these being insoluble in water or dilute alcohol, but soluble in xylol and similar solvents; and (*b*) unorganized color principles, which are not a fundamental or organic part of the plastid, these occurring in the vacuoles of the cells of the higher plants as well as fungi, and in the vacuolules of the plastids of the brown and red seaweeds, being further distinguished by being soluble in water and dilute alcohol and insoluble in xylol and similar solvents.

2. In the photosynthesis of the chloroplast the unorganized color substances may be produced in comparatively large amounts, as in (*a*) early spring foliage; (*b*) autumnal foliage; (*c*) the foliage of alpine plants; (*d*) the brown and red marine algæ; (*e*) the foliage of certain species or varieties of rose, beech, nasturtium, etc.

3. The original color of the unorganized color principle is neither blue as stated by Wiesner, nor red as given by Berzelius; but these colors, namely, blue and red, and their various shades and tints are dependent upon substances dissolved in the cell sap and which are associated with the color

substance; or are the result of decomposition or oxidation processes.

4. Unorganized color substances are distributed usually in largest amount at the terminus of the branch, as in foliage and flowers, or in roots, or in both tops and roots.

5. The wide distribution of so-called flower color substances in other parts of the plant than the flower, points to the conclusion that they are products of plastid activity, and are not to be considered as designated primarily for the attraction of insects when found in the flower.

6. The occurrence of chromoplasts in a reserve organ, as the tuberous root of the carrot, and the similar occurrence of chromoplasts and of reserve starch in the petals of the buttercup, suggests that the petals of the buttercup like the root of the carrot have the function of storing nutrient material. In both cases cells containing chromoplasts rich in nitrogenous substances are associated with cells containing reserve materials.

Some Undescribed Fossil Trees from the Eocene of Vermont: Professor E. C. Jeffrey, Harvard University.

As a result of the coal famine of the winter of 1902–3 the lignite beds of Brandon, Vt., were considerably exploited for fuel. A number of more or less well preserved specimens of wood were secured by Professor Perkins, of the University of Vermont, and communicated to the author for identification. A few pieces of the material were in a good state of preservation and proved to be a species of *Laurinoxylon*. Nearly all the remaining fragments belonged to a single species, which proved to be very badly decayed, so that it has not been possible as yet to determine it satisfactorily.

New Data Bearing on the Phylogeny of Pinus (illustrated): Professor E. C. Jeffrey, Harvard University.

As the result of the study of both internal and external features in a large number of species of *Pinus* ranging throughout North America, Europe and Asia, the following conclusions have been reached:

The genus *Pinus* is divisible into two series, *Scleropitys* and *Malacopitys*, which are not coincident with the sections *Pinaster* and *Strobus* of recent authors. In *Scleropitys* the cones (female) are generally strongly sclerified, and are often provided with a prickle or spine on the generally median umbo, especially when young; leaf-sheath persistent; leaf-trace double; two or more rows of resin canals in the first annual ring of wood, one of which is near the pith; marginal cells of the wood-rays dentate. In *Malacopitys* the cone (female) is of softer texture, and is generally quite without a prickle or spine on the generally terminal umbo; leaf-sheath deciduous; leaf-trace single; a single series of resin canals in the first annual ring of the wood, not near the pith; marginal cells of the medullary rays not dentate. Internal features of structure are of greater constancy and consequently of more value in tracing the larger lines of affinity in the pines.

The Bud Rot of the Coconut Palm in the West Indies (illustrated): Dr. Erwin F. Smith, Department of Agriculture.

General attention was first called to this disease by the reports of army officers during the American occupation of Cuba. The coconut palms were said to be dying in large numbers of some mysterious disease which should be investigated. Mr. Busck was sent by the U. S. Department of Agriculture to eastern Cuba, and subsequently reported on the entomological aspects of the disease. Later Mr. F. S. Earle reported the occurrence of a bacterial bud rot of the coconut in Jamaica. The writer has since heard of its occurrence on the mainland in Central America, so that it may be assumed to occur all round the Caribbean. It was studied by the writer at Baracoa, Mata and Yumuri in eastern Cuba in April, 1904.

The disease has made decided advances since it was studied by Mr. Busck in 1901, especially at Mata, and if it continues to spread as it has done during the past ten years it will inevitably destroy the coconut industry of the island, and that, too, within the next ten or fifteen years. Already many of the planters are discouraged and not setting any more trees, since it now attacks trees of all ages, including quite young ones and those on the hills as well as those close to the sea. The disease is frequently known as 'the fever,' and often one sees where the bases of the trunks have been scorched with an idea of preventing the development of the disease. The disease is not lodged in the roots, however, nor in the stem. These in all cases appeared to be sound. The general symptoms are the yellowing and fall of the outer leaves, the shedding of the nuts, and some months later the death of the whole crown. The cause of this decline is not apparent until the tree is felled and the crown of leaves removed, including the wrappings of the strong terminal bud. The latter is then found to be the seat of the disease. This bud with its wrappings of young and tender leaves is found to be involved in the vilest sort of a bacterial soft rot—not unlike that of a decaying cabbage or potato, but smelling much worse, the stench resembling that of a slaughter-house. This rot, invisible until the numerous outer leaf-base wrappings are removed, often involves a diameter of several inches of soft tissues and a length of three or four feet, including flower buds and the whole of some of the soft fleshy white undeveloped leaves covering the bud and forming the so-called 'cabbage' of the palm. The rot stops very promptly with the harder tissues of the palm stem immediately under the bud and does not attack any of the developed leaves. It is a disease of the undeveloped tissues. When the tree is felled and opened up, carrion flies and vultures are promptly attracted by the horrible smell. Fly larvæ and various fungi were found in the parts most exposed to the air and longest diseased, but the advancing margin of the decay was occupied only by bacteria, of which there appeared to be several sorts. No yellow or green fluorescent bacteria were obtained from the rotting tissues. All were white organisms of the 'soft-rot' type, mostly plump short rods with rounded ends, but occasionally longer rods, all apparently gas producers. One of the commonest sorts formed round dense creamy white opalescent colonies on agar. Another formed thin gray-white iridescent colonies on agar. A terminal spore-bearing, tetanus-like organism was also often abundant in the decayed tissues, even close to the advancing margin of the rot, and this is probably an anaerobe as it was not obtained in any of the many cultures.

The picture of one diseased tree will answer for many. No fungi or insect injuries were found which could in the least account for the death of the trees. The disease is the result of a bacterial rot of the terminal bud and its wrappings, including the flower buds. The bacteria probably find their entrance through wounds of some sort, and their distribution is undoubtedly favored by carrion creatures. The larva found deepest down in the rotting tissues was that of the common scavenger fly, *Hermetia illucens* L. Occasionally the crown of a tree was found yellow from other causes, but if the youngest visible leaf (projecting five or six feet) was observed to be lopped over and wilting or shriveled, the soft rot was sure to be found on cutting down the tree and removing the close-wrapped leaf bases. No attempt has yet been made to produce the disease by pure cultures.

Diseased trees should be felled and the terminal bud burned or properly disinfected with sulphate of copper. Only the most energetic action is likely to avail.

Some Diseases of Loblolly Pine Timber: Dr. Hermann von Schrenk, Department of Agriculture.

The wood of the loblolly pine when still in the living tree is destroyed by several fungi, notably *Trametes pini* and *Polyporus Schweinitzii.* After the timber is cut from the tree, it is very susceptible, particularly in southern climates, to fungus attacks, and is probably the least resistant of all American woods. A number of fungi grow on the outside of the timber, notably *Schizophyllum commune* and several Thelephoraceæ. These, however, do not attack the wood fibers, but grow on the sugar, starch or exuding resins. The worst enemy of the loblolly pine timber is *Lenzites sepiaria,* which causes the brown rot. The description of the various forms of fruiting bodies of this fungi were given, and an account of the experiments which were made during the last year to test the susceptibility of this timber, when cut during different months of the year. It was shown that by proper piling, the attacks of this fungus ought to be prevented for periods of at least twelve months.

Bacterial Infection by Way of the Stomata in Black Spot of the Plum: Dr. Erwin F. Smith, Department of Agriculture. (By title.)

Experiments were continued during the summer of 1904 with the bacterial black spot of the plum, and numerous infections by way of the stomata were obtained on leaves and green fruits by simply spraying upon the tree, agar-cultures of *P. pruni* dissolved in sterile water. This was done during a damp still evening, in which several light showers occurred. The spots were visible at the end of seven days and continued to increase for several weeks in the typical manner. Microtome sections in early stages of the spots show abundant bacterial occupation, beginning in the substomatic chamber. The organism was also recovered from the spots by means of agar poured plates in pure culture. A neighboring tree inoculated at the same time and in the same way, but with a different yellow organism, never showed any results of this copious inoculation. Neither did any spots develop on a second check tree. The disease appears to be one of meristematic tissues. No spots were obtained on full-grown green plums, inoculated two or three weeks prior to their ripening, although numerous attempts were made under what appeared to be very favorable conditions.

Burrill's Bacterial Disease of Broom Corn (illustrated): Dr. Erwin F. Smith and Miss Florence Hedges, Department of Agriculture.

In the summer of 1904, on one of the Agricultural Department farms in Washington, D. C., this disease was observed in such abundance and with such typical characteristics as to remove all doubt as to its origin. The elongating red-brown blotches were extremely numerous and fused readily, causing the death of many large leaves. The disease began on the lower leaves; but by the end of September it had reached the top of the plants (twelve feet) and had destroyed all leaves on the lower six feet, and badly spotted the remainder. A microscopic examination of various spots showed a bacterial focus to be present in each one. Poured plates made from these spots on several different occasions yielded bacteria in enormous numbers, of one kind and in practically pure culture. Very characteristic also was the appearance on the under surface of the spots (the season was wet) of red crusts or scabs. These were so numerous as to be quite conspicuous. They consisted of bacteria which had oozed from the interior of the spots.

The infection takes place by way of the stomata and is favored by rainfall or dew-fall. No insect injuries are necessary. The disease was obtained in the hot-house under strict control conditions by dissolving pure slant-agar cultures of the organism in sterile water and atomizing this upon the plants. Spots were visible at the end of ten days and were well developed in five or six weeks. Such spots contained the characteristic bacterial focus and yielded, on making poured plates, enormous quantities of the organism used, and in most cases nothing else. The disease was likewise produced in broom corn, starting with bacterial colonies obtained from leaf spots on field sorghum.

The red stain is a host reaction. The organism is not red, nor yellow, but pure white. It is not a yeast and is not associated with yeasts or with fungi. It does not produce gas but is strictly aerobic in peptone water with various carbon foods (dextrose, saccharose, lactose, maltose, mannit and glycerine). It forms small, round, white, slow-growing shiny surface colonies on agar plates. The growth on agar is often sticky and hard to remove; the organism blues litmus milk decidedly, and finally renders it gelatinous; it does not liquefy gelatin, does not reduce nitrates, produces little if any indol, grows very slowly on moist silicate jelly made with Fermi's solution, has little diastasic action on potato starch jelly. On potato cylinders growth is white and much the color of the potato; grays the potato moderately; clouds bouillon moderately. In bouillon there is a thin white rim, and in old cultures often zooglœæ and sometimes a thin pellicle breaking down easily. Slow, long-continued growth in Uschinsky's solution, not much precipitate. Resisted drying 96 hours. Grows not at all or very feebly at 37.5° C.; grows more rapidly at 30° than at 20° C.; minimum temperature about 6° C. Thermal death point 47° C. Stands freezing well, *i. e.*, only about 20 per cent. killed. Occurs in the host plant and in culture media as a short rod with rounded ends, single or in pairs or rarely fours. It is motile but non-sporiferous, so far as yet observed.

Some varieties are much more subject to the disease than others, and there is good hope of overcoming the disease by selecting resistant plants for propagation.

Pecan Scab (*Fusicladium effusum* Wint.): Mr. W. A. Orton, Department of Agriculture.

This paper will be published later as a bulletin of the Bureau of Plant Industry, U. S. Department of Agriculture. It describes a disease of considerable economic importance, caused by the above-named fungus, which attacks the leaves, twigs and nuts of cultivated pecans in our southern states. The fungus occurs on either side of the leaves and on the petioles, producing dead spots or distortions and defoliation. The new growth of the twigs is sometimes killed, but the greatest injury is to the nuts. The microscopic and cultural characters of the fungus were described. *Fusicladium caryigenum* E. & L. was found to be the same species. Favorable results from spraying experiments were reported.

Factors which Determine the Spread of Pear Blight: Mr. M. B. Waite, Department of Agriculture.

(It has been impossible to obtain an abstract of this paper.)

Further Studies on the Starch Grain (third paper): Dr. Henry Kraemer, Philadelphia College of Pharmacy.

The author called attention to the alteration in the compound starch grains of the seeds of *Theobroma Cacao* on the application of heat, producing masses resembling the natural starch grains of corn, wheat, barley, rye and potato, in size and shape, and showing in some cases even a concentric or excentric lamellated structure.

In the micro-polariscopic examination of reserve starch grains of different origin, it was observed that in using a red and green selenite plate the yellow and blue areas did not occupy the same relative position in all of the grains, so that in the same field with the analyzer at a given position two kinds of grains were observed which were the complement of each other. Three explanations are suggested as accounting for this difference in the polarizing effects of different starch grains of the same origin:

1. It may be due to a difference in the shape and structure of the individual grains.

2. It may be due to a difference in composition of the different parts of the same grain.

3. Or it may be that there are two distinct kinds of grains. This view seems to offer the most plausible explanation for this phenomenon.

Regarding the Cause of Sap Pressure and Flow in the Maple: Dr. K. M. Wiegand, Cornell University.

Researches by various investigators have shown that the seat of pressure in the maple, during the sugar season, is not in the root, but in the aerial parts, principally in the trunk. It seems to be induced by temperature acting as a stimulus. When this rises past 2°–4° C. pressure results, but a freezing of the tissue is by no means necessary. The author has attempted, by the aid of mathematical calculation and the employment of other evidence at hand, to compare critically the various theories. It becomes evident that neither gas, water nor wood expansion, nor any combination of these, can account for the phenomenon. Neither can the freezing theory. We have left the theory that pressure is due to the living cells, which agrees well with the facts. Only the pith rays seem to be in the proper position in the wood to allow the production of pressure. Pressure in this case could be due only to the unequal permeability, in opposite directions, of the membrane at the two ends of the cell. This, quite likely, is caused by the penetration of the morning temperature. Water would tend to pass from the inner layers to the outer; and the solute, sugar, would be excreted as a necessary factor in the production of pressure.

Notes on Some Species of Agaricus (Psalliota): Professor G. F. Atkinson, Cornell University.

Photographs of eight or ten species were shown to illustrate characters and show some points in the development and formation of the veil and annulus. Photomicrographs of the spores of nearly all the species in the United States were also shown, and special attention was called to the value of these in a study of different species.

Nuclear Changes in Germinating Seeds: Professor Carrie M. Derick, McGill University.

In this paper a brief summary was given of the results of part of an investigation into the cytological conditions connected with anabiosis which had been begun under the direction of Professor Strasburger, at Bonn, and continued at McGill University.

Studies of resting seeds belonging to several genera and of germinating seeds indicate that the nucleus of the resting seed is homogeneous, with the exception of the nucleolus in which the chromatin is aggregated. As the nucleus passes from the resting to the active state, the nucleolus becomes vacuolated, and chromatin is gradually given off by it and distributed in the form of granules throughout the body of the nucleus. These granules increase in size and number and finally are aggregated to form the spireme, which segments, as usual, into chromosomes. The chromosomes do not, therefore, retain their individuality throughout the life-cycle of the organism, and are not constantly present as the differentiated bearers of the hereditary qualities of the plant.

The Recognition of Hybrid Characters in the Structure of the Vascular Cylinder as Expressed in the Genus Catalpa: Professor D. P. Penhallow, McGill University. (Presented in synopsis.) In 1889 Professor C. S. Sargent published an account of an interesting and newly observed case of hybridization between two species of *Catalpa* which he designated as *Catalpa* × J. C. Teas in reference to the origin of the tree in the nursery of Mr. Teas of Carthage, Mo. The account referred to states that *Catalpa kaempferi* was planted in 1864 in a nursery containing *C. speciosa* and *C. bignonioides.* Eventually the first species produced a single pod of seeds which were wholly unlike anything hitherto known. When these seeds were planted they produced a tree almost intermediate in character between *C. kaempferi* and one of the American species. Mr. Teas was of the opinion that the cross was with *C. speciosa,* while Professor Sargent considered *C. bignonioides* as the other parent, basing his conclusions upon the fact that the flowers of *C. speciosa* were two to three weeks earlier than those of *C. kaempferi,* while the flowers of *C. bignonioides* are contemporaneous with those of the Japanese species. No other evidence has since been forthcoming, so far as I am aware, and the real American parentage of a most noteworthy addition to the ornamental trees of this country still remains in doubt. Within the last twelve years, opportunities have been presented to inquire into the evidence which might be secured from an anatomical point of view, and to determine to what extent, if any, the external alterations attendant upon hybridization were accompanied by corresponding internal structural changes. It was felt that the answer to this question might very largely contribute to a solution of the difficult problems relating to the origin of species, either by mutation or by hybridization, and permit of a more precise limitation of the characters which define a species.

An examination of typical material taken from the mature stem of the hybrid and from each of the possible parents, showed that the characters were to be most clearly recognized in transverse and tangential sections, especially in the former. A very careful analysis of all the structural features showed that out of a possible maximum of thirty-two, 34 per cent. were common to *Catalpa speciosa* only, and from the well-defined characteristics which it exhibited, it was possible to eliminate it from further consideration and to definitely determine that it could not be one of the parents. On the other hand, it appeared that there were 31 per cent. of characters common to the hybrid, *C. bignonioides* and *C. kaempferi,* while in the hybrid it was also possible to determine features which could not be accounted for except as the resultant of action between *C. kaempferi* and *C. bignonioides.* The evidence available shows that:

1. Hybrid characters are expressed in the structure of the vascular cylinder as well as in external alterations of form and color.

2. *Catalpa speciosa* is not in any way concerned in the production of the hybrid.

3. Teas' hybrid *Catalpa* is the product of a cross between *C. kaempferi* and *C. bignonioides*, thus confirming the conclusions already reached by Sargent on the basis of external morphology.

4. The dominant characters of the hybrid, as expressed in the internal structure, are those of the Japanese parent as similarly manifested externally.

5. The resultant characters are most strongly exhibited in transverse section, less so in the tangential and least of all in the radial.

6. Teas' *Catalpa* presents a degree of stability directly comparable with that exhibited by the willows, various species of *Cratægus* and many other plants which are commonly recognized as distinct species. Its origin is in direct harmony with Mendel's law and it should be given the status of a species for which the name *Catalpa teasi* is appropriate.

Polyembryony in Celtis (illustrated): Professor J. W. Toumey, Yale Forest School.

In the spring of 1901, 500 of the normal one-seeded fruits of *Celtis occidentalis* were planted. Seedlings grew from 98 per cent. of these fruits. The total number of seedlings obtained, however, was 580; that is, a little more than 10 per cent. of the fruits sown produced more than one seedling.

In 1902 and again in 1903 the drupaceous fruits of this species were again sown, with similar results. In 1903 the fruits of *Celtis reticulata* and *Celtis Mississippiensis* were sown. Both of these species, in some instances, developed more than one seedling from a single fruit, but not so frequently as in *Celtis occidentalis*.

On examination of a large number of ovaries in various stages of development, and mature fruits of *Celtis occidentalis* it was found that the development of more than 1 embryo in a single fruit arose as follows: (1) From double fruits. In 1,000 fruits examined 3 double ones were found. (2) From the development of two seeds within the same fruit. In 400 fruits examined 7 were found which contained 2 ovules each. In each of these cases one ovule was much larger than the other and both were attached to the wall of the ovary by a common funicle, indicating that they both arose from the same fundament. (3) From true polyembryony. In 200 of the young ovules that were fixed and sectioned 16 were found with from 2 to 4 embryos within a single embryo sac. In these cases the embryo arose directly from the tissue of the nucellus at the micropylar end of the ovule. When seeds, containing ovules resulting from true polyembryony were sown usually all of the embryos developed, as high as 4 developing from the same seed. The young seedlings that developed from such embryos were often imperfect and more or less grown together. Occasionally, however, they were approximately the same size, perfect and wholly separate. (4) From false polyembryony. From 200 of the young ovules fixed and sectioned 3 were found where 2 nucelli developed within the same integuments. Each nucellus developed an archesporium and ultimately an embryo sac. Assuming that both embryo sacs become fertilized and develop normally we would here have a case of 2 embryos within common seed coats; both developing from fertilized eggs. This is believed to be very unusual among angiosperms.

Nymphæa and the Monocotyls: Dr. Henry S. Conard, The Johns Hopkins University.

The speaker discussed some observations on the structure and development of

Nymphæa from a paper now in press. The embryo in its development and mature form is typically dicotyledonous in *Nymphæa,* though it lacks a suspensor in *Nuphar.* The primary root quickly perishes, and the stem becomes tuberous immediately above the epicotyl. The root tip of *Nuphar* resembles that of *Zea mais,* but in *Nymphæa* it is like that of Papilionaceæ and Cucurbitaceæ. The vascular bundle of the root of *Nymphæa* is radial and polyarch. The scattered bundles of the stem of *Nuphar* and some *Nymphæas* give place to a distinct vascular cylinder with leaf-gaps in the primitive *Nym. mexicana.* In no case are the bundles oriented as in monocotyls. From each leaf three traces come into the stem, one central and two lateral; they differ from many dicotyls only in possessing a transverse commissure connecting the three traces. No secondary growth of the bundles takes place in any part of the plant. In this and in the polyarch roots and in the short life of the primary root are the only similarities between *Nymphæa* and the monocotyls. These are best explained as adaptations to a long established aquatic habit.

An Exploration of a Peat-forming Lake (illustrated): Dr. G. P. BURNS, University of Michigan.

Perhaps no line of ecological research shows the deficiency of present methods better than the work on peat bogs. These are cited as examples of 'xerophytic' habitats and there are many theories offered explaining the presence of plants growing in them.

These theories differ widely. Nor can we expect them to do otherwise under present methods.

The first problem of the ecologist must be to gather and record facts, but these must be submitted, as far as possible, to experiment before attempting to determine their final value. As in all other lines of botanical research, experimental work is indispensable.

A study of the plants in peat-forming lakes near Ann Arbor, Mich., shows that they are by no means all xerophytes. With xerophytes are found many plants whose structure is either mesophytic or hydrophytic.

In fact, within a circle whose diameter is only a few feet may be found plants belonging to all three of these groups of plants.

Peat bogs then, as such, can not be called 'xerophytic' habitats.

W. F. GANONG,
Secretary.

SCIENTIFIC BOOKS.

Die Gletscher. By Dr. HANS HESS. Braunschweig, Friedrich Vieweg und Sohn. 1904. Large 8°, pp. xi + 426.

This is the only important work on glaciers that has appeared since the well-known book of Professor Heim was published in 1885, and it is of the same general excellent character. Dr. Hess has had a good preparation for writing the book by his training as a physicist, which is of much importance in the actual study of glaciers, and by many years of careful observations and measurements of the glaciers of the Oetzthal in conjunction with Professor Finsterwalder and Dr. Blümcke; and he makes many references to the very important observations which they have made, especially on the Vernagt and Hintereis glaciers, which have thrown so much light on the theory of glacier motion.

The plan of the book does not differ essentially from that of Professor Heim. The matter is presented inductively; first assembling the observations and facts and then giving the theories to account for them. The large amount of work which has been done in the last twenty years makes such a work very desirable and Dr. Hess has collected all the material and has presented it in a most attractive and interesting form.

He begins by giving the physical properties of ice with accounts of the experiments for determining the plasticity and other constants. The climate of glacial regions is considered, and then the forms of glaciers, which leads to a study of the position of the névé line; he gives the different methods for determining the height of this line, one of which, due to Dr. Hess, depends upon the forms of the contour lines above and below the névé line and can be used when one has a good contour map. Dr. Hess divides glaciers into two general classes; the Alpine type or the valley glaciers and the inland ice type, and says that these two are not separated by any definite line but that they gradually grade into each other through glaciers of intermediate type. A description of the general distribution of glaciers over the world completes the first part of the work.

The movement of glaciers is then discussed and many determinations of velocity are given. The very incomplete observations which we have bearing on the changes of velocity in passing from the surface to the bed, is supplemented by the observations of Dr. Hess, in which he shows by means of the theory given further on, that the average velocity through a particular section of the Hintereis glacier is less than the average velocity of the surface. The thickness of the ice was determined by borings which completely pierced the glacier, one of which was 153 meters deep. Dr. Hess was convinced, as a result of his general observations, that the blue bands of glaciers were merely modified strata, and by means of an artificial glacier, made up of layers of different colored wax, succeeded in making the original layers take the forms which the bands assume. In the chapter on 'Ice and Rock,' the phenomena of moraines, superficial and internal, are described, following the classification adopted at the Rhone conference in 1899. He considers that glaciers are strong erosive agents and fortifies this view by a measurement of the quantity of material being brought to the surface by one of the internal moraines. The origin of this moraine he follows to a snow-covered peak in the region of the reservoir, whose character is such that he thinks the material could not have fallen from its surface and must therefore have been derived from the glacier's bed. In the chapter on 'The Ice Age' he also shows how the valleys have changed their shapes into the well-known glacial troughs.

A very interesting account is given of the variations of glaciers. Beginning with the seasonal changes, he goes on to describe the larger variations which follow Bruckner's period and he collects together the observations that have been made on this subject. He considers that the main cause of the glacial variations are variations of climate but that this is greatly modified by topographic conditions. Glaciers like the Vernagt, which have a large basin-like reservoir and a narrow tongue, do not begin to advance until there has been a large collection of snow in the reservoir and then the advance takes place very rapidly; whereas another glacier, whose outlet from the reservoir is broad and open, will probably respond quickly to climatic changes. He describes very interesting changes that have taken place in the Vernagt glacier since 1895, when the accumulation in the reservoir began to show itself; the end continued to retreat until 1897, after which came an advance. This advance seems to have run its course as the glacier is now about stationary. The observations showed that the ice grew thicker in the reservoir and that what might be called a wave advanced along the glacier to its end, very greatly increasing the velocity of the ice and itself moving still more rapidly. The historical theories of the cause of glacial motion are described; Dr. Hess looks upon the plasticity of ice as the property which allows it to flow. It is only at this point that he takes up the geometrical theory of glacial motion, given simultaneously by Finsterwalder and by Reid, and describes the lines of flow and the relations existing between accumulation, flow and melting. This theory is so fundamental in its bearings on all glacial phenomena that it might have been given with advantage in an earlier part of the book. This is followed by an account of Professor Finsterwalder's mathematical theory of glacier variations. In this theory, Professor Finsterwalder expresses the fact that the increase in any section is equal to the difference between the ice which enters and leaves it, less the amount melted. Assuming that the velocity is in proportion to the square root of the thickness, that the melting is proportional to the horizontal projection of the surfaee and that there are certain fundamental variations of thickness at the névé line, which may be eonsidered as due to climatic ehanges, Professor Finsterwalder finds that a glacier will go through variations whieh correspond very well with those observed. This is a most excellent beginning of a more exact understanding of glacial variations, though the assumptions are by no means aecurate. The last chapter contains an account of the 'Iee Age' with special descriptions of the Alps in that period and describes the ehanges which have taken place in the topography as a result of the occupation of the valleys by the glaciers. The Ice Age, of course, ean not be treated fully exeept in one or more volumes by itself.

In conelusion, we may say that the book is well and clearly written and is thoroughly reliable in its facts; it will be of the greatest value to all students of glaeiers.

HARRY FIELDING REID.
JOHNS HOPKINS UNIVERSITY,
March 11, 1905.

The Varnishes of the Italian Violin Makers of the Sixteenth, Seventeenth and Eighteenth Centuries and their Influence on Tone. By GEORGE FRY, F.L.S., F.C.S. London, Stevens and Sons, Ltd. 1904.

About a fifth of the book deals with the minute description of the old violin varnishes as used by the best Italian makers. This is important as it is the only means of determining the composition of them, for it is clearly out of the question to remove the varnish from Straduarius violins and analyze it.

Following this is a ehapter upon the influence of varnish upon the tone of violins, in which is shown that it has a decided influence and that oil rather than spirit varnishes are to be preferred. Two chapters are devoted to the manufacture of oil varnishes and those from turpentine derivatives.

The most important part of the book is contained in the last two chapters, in which the author thinks it more reasonable that the varnishes used in Italy were made from the materials close at hand—turpentine, linseed oil and rosin, the latter oxidized by treatment with nitric acid—than from some remarkable mystical gum. He substantiates his theory by describing a series of sixteen experiments in the manufacture of varnishes, using a nitrated mixture of rosin and linseed oil. A number of interesting problems are discussed, as, for example, the produetion of dichroism in varnishes, and studies in the drying of varnishes, the fact that age in violins is a detriment rather than an advantage, as usually supposed. Incidentally it should be remarked that the processes of manufacturing the nitrated varnishes have been patented in this eountry and abroad. The work is a valuable one to both the violin and the varnish maker, particularly to the latter on account of the material relating to the nitro-oleo varnishes which, so far as the reviewer is informed, is new.

A. H. GILL.

SCIENTIFIC JOURNALS AND ARTICLES.

THE opening artiele in the *Journal of Nervous and Mental Diseases* for March is by Dr. H. A. Hoppe, who discusses under the title of 'Soul Paralysis' some very interesting problems of the higher reflex acts, dealing with the relation between sensory stimuli and motor activity. This article is followed by a careful report by Dr. F. Robertson Sims of the 'Anatomical Findings in two Cases of Korsakoff's Symptom-complex.' Dr. Charles W. Burr reports a case of myasthenia gravis with autopsy, adding one more to the list of cases in which the thymus gland was persistent or persistent and diseased in the adult and associated with lymphoid infiltration of the museles. The case is particularly interesting clinically because of the presence of visual symptoms, most frequently met with in and formerly regarded as pathognomonic of hysteria. Dr. S. G. Webber adds two more eases to the literature of multiple sclerosis, and suggests that the apparent rarity of the disease may be partially due to failure to get eorrectly diagnosed, the cases in question having been diagnosed as tumor of brain and locomotor ataxia, respectively, and their true nature revealed only by the autopsy. The proceedings of the Philadelphia Neurological Society for November 22, 1904, are reported, and the 'Periscope' contains numerous abstracts.

SOCIETIES AND ACADEMIES.

THE AMERICAN MATHEMATICAL SOCIETY.

The one hundred and twenty-second regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, February 25, 1905. The attendance at the two sessions was about fifty, including forty-two members of the society. The vice-presidents, Professors Pierpont and E. W. Brown, presided at the morning and afternoon sessions respectively. The council announced the election of the following persons to membership in the society: Miss A. F. Becker, Yeatman High School, St. Louis, Mo.; Professor C. H. Beckett, Purdue University; Professor W. De W. Cairns, Oberlin College; Professor S. C. Davisson, Indiana University; Dr. J. S. French, Jacob Tome Institute; Mr. F. H. Hodge, Clark University; Mr. A. E. Joslyn, Armour Institute of Technology; Dr. J. W. Lowber, Austin, Texas; Mr. J. H. Maclagan-Wedderburn, University of Chicago; Mr. G. A. Plimpton, New York City; Mr. E. W. Ponzer, University of Illinois; Mr. H. W. Reddick, University of Illinois; Miss M. E. Sinclair, University of Nebraska; Dr. A. W. Smith, Colgate University. Ten applications for membership were received.

Professor E. B. Van Vleck was elected a member of the Editorial Committee of the *Transactions,* to succeed Professor T. S. Fiske, who retires with the completion of the present volume.

The following papers were read at this meeting:

L. D. Ames: 'The theorem that a closed simple surface is bilateral.'

C. L. Bouton: 'Note on isothermal curves and one-parameter groups of conformal transformations in the plane.'

E. W. Brown: 'Note on the variation of the arbitrary and given constants in dynamical equations.'

O. E. Glenn: 'Determination of the abstract groups of order p^2qr.'

F. R. Sharpe: 'The stability of the motion of a viscous liquid.'

James Pierpont: 'Note on infinite products.'

Charlotte A. Scott: 'The elementary treatment of conics by means of the regulus.'

A. W. Smith: 'The symbolic treatment of differential geometry.'

A. M. Hiltebeitel: 'Note on a problem in mechanics.'

R. B. Allen: 'Hypercomplex number systems with respect to a domain of rationality.'

L. P. Eisenhart: 'Note on the deformation of surfaces of translation.'

A meeting of the San Francisco Section of the society was also held on February 25, at Stanford University. The next meeting of the society falls on Saturday, April 29. The Chicago Section will meet at the University of Chicago, April 22. The summer meeting of the society will be held at Williams College, Williamstown, Mass., September 7–8.

F. N. Cole,
Secretary.

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

At the meeting on March 6 the following paper was read by title:

On the Absence of Helium from Carnotite: Dr. E. P. Adams.

The following paper was presented in full:

Notes on the Minnewaska Region, Ulster Co., New York: F. Wilton James.

The stripping of the grit from the crest of the second anticline of the Shawangunk* appears to be due to a slight cross fold by anticlinal fracture and erosion, as the rocks at the southwest end of the eroded area show an upward pitch. Through this depression the Peterskill probably flowed while its own valley and Coxing Clove were dammed by the front of the ice sheet, and cut then the Paltz Gap in the crest of the first anticline, 200 feet deep, through which the road to New Paltz now runs.

* Darton, Rep. 47, N. Y. State Mus.

The basin of Lake Minnewaska is vertical-walled except at the southwestern end. The cliffs are highest under Cliff House, where they stand 160 feet above the surface of the lake and 65 feet below it. The grit is probably about 230 feet thick here. The walls are pierced by four crevasses now filled with drift—the remains of two fissures crossing each other at the deepest point in the lake, 74 feet deep. There is no drift in the lake basin, not even under the south-facing cliffs, although the fissure running S. 25° W. is filled, and the transverse breach is blocked to 150 feet above the lake. The glaciation is here S. 10° W. The cause of the absence of drift is not clear; elsewhere the cliffs are heavily skirted.

Lake Awosting lies along a vertical fault plane drift filled at both ends. The fault has not been studied. The north wall of the Palmaghat is a vertical fault of 200 feet throw. Both these faults seem to be derived from the overthrown anticline of the Coxingkill escarpment. Mr. Darton is in error in declaring the absence of extended faults.

The next paper was by Dr. A. A. Julien on the 'Determination of Brucite as a Rock Constituent.'

After a brief review of the life of Dr. Archibald Bruce, of New York City, the discoverer of the mineral, the fact of its wide distribution was set forth, both in limestones and serpentinoids, either in its unchanged condition or in the form of its derivatives, especially magnesite and hydromagnesite, as maintained by Volger in 1855. The following are its most marked characteristics for recognition as a rock constituent.

1. In addition to the known basal cleavage, two other systems may be distinguished on plates or folia; that of the hexagonal prism, often becoming rhombohedral, intersecting at 60° or 120°; and that of the hexagonal pyramid, intersecting at 90°.

2. Nemalitic structure or fibration, commonly occurring in brucite within serpentinoids subjected to dynamic stresses. The major axis of elasticity always lies parallel to the direction of the fibers.

3. Refractive index 1.57, sufficient, when the associated minerals are pure, to distinguish it by the Becke method from serpentine on the one hand and from amphiboles, dolomite, etc., on the other.

4. Birefringence ($\gamma - \alpha = 0.020$), presenting interference colors of the upper first order up to sky blue of lower second order, in plates or sections of the usual thinness.

5. Characteristic strain phenomena; particularly by disturbance of the interference figure, examined by convergent light in basal cleavage plates or folia; also by a variable, small extinction angle in sections parallel to the vertical axis.

6. Optically positive character of the uniaxial figure, in distinction from talc, serpentine, etc.

7. Occasional twinning, observed in crystals enclosed in limestone.

8. Certain chemical tests, in confirmation of the optical diagnosis.

A. W. Grabau,
Secretary.

Columbia University.

THE TORREY BOTANICAL CLUB.

The meeting was held at the New York Botanical Garden, February 22, 1905, Professor L. M. Underwood in the chair and twenty-one members present.

A contribution to the local flora by Mrs. Livingston and Miss Crane was communicated by W. A. Murrill and read by Professor Underwood. The authors had worked on the fungi, and had identified 195 species in 82 genera and 17 families, all from Searsdale, N. Y. The balance of the program consisted of remarks on the genus *Lycopodium*, being some of the results of the joint labors of Professor F. E. Lloyd and Professor L. M. Underwood, which will soon be published in the *Bulletin*, Professor Lloyd spoke from a morphological standpoint and Professor Underwood from a more general one.

Professor Lloyd called attention to the differences which were found to be diagnostic, that were brought out by the wet method used for the investigations, differences not distinguishable in dried material. The lycopods fall naturally into two physiological groups as shown by their morphological characters, dependent upon habit—a radially symmetrical type for those species which are erect or pendent, and a bilaterally symmetrical type which may be purely physiological due to a twisting of leaves or stems or to the development of dimorphism in the leaves. Many interesting features were brought out with the aid of the blackboard.

Professor Underwood spoke of the number of new species brought to light by recent exploration, and comparative study of material from the American tropics, scarcely any of which are common to the United States. The lycopods which in our latitude are inconspicuous and comparatively infrequent, in the tropics occasionally become weeds of large size and great beauty, growing especially in high altitudes, in fact most of the more interesting tropical Pteridophyta are found above the 5,000-foot level. Many specimens were exhibited.

Edward W. Berry,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 597th meeting was held February 18, 1905.

Mr. J. W. Spencer, of the Hydrographic Office, presented a number of physiographic charts showing drowned river valleys and continental slopes in various parts of the ocean, and from these argued 'On the Physiographic Improbability of Land at the North Pole.'

The continental shelf north of Eurasia is now known to attain a breadth of 300–350 nautical miles, with its border reaching to a general depth of 300 feet, though there is a lower platform (to 1,200–1,500 feet in Barentz Sea). Beyond this edge, Nansen discovered the great continental slope down to 12,000 feet. This discovery precluded the occurrence of land until islands should be found on the American shelf, the position of which has not been observed. From the occurrence of fjords reaching from 1,200 to 4,000 feet on the eastern side of the American archipelago; of others to over 2,400 feet on the northern side, at a point even 200 miles within the line of the archipelago, and from the occurrence of deep fjords on three sides of Beaumont Sea to the west, it may be concluded that the continental shelf will be found at 50–100 miles north of the present known line of islands. This would correspond with the general characteristics of continental shelves trenched by deep fjords and valleys off the coast of Norway, Greenland and elsewhere. Accordingly, from all physiographic analogies, there is no reason to expect land within 300 miles of the pole or a little more. When explorers shall have reached a point north of Grant Land, where the depth is even less than 2,000 feet, they will have established the fact that there is a sea extending to the Siberian side, and scientifically their work will have been completed in the polar region.

Dr. Harris, of the Coast Survey, urged briefly that these conclusions were irreconcilable with the conclusions he had presented some months ago based on the study of tides and currents in the Arctic Basin.

Interesting memorial addresses were read, one by Dr. W. H. Dall on Marcus Baker, a past president of the society, the other by Mr. H. G. Ogden on Adolphus Lindenkohl, late the chief map draftsman of the Coast and Geodetic Survey.

Mr. Edwin Smith then spoke on 'The New Transpacific Longitude Determinations.' The probable error of the longitude of Manila *viâ* the United States is .059 sec.; the new determination agrees with the mean of the older ones *viâ* Asia (which are not wholly corrected for personal equation) within the error stated. The results have already appeared in Science.

Mr. E. G. Fischer exhibited and described the 'Rapid Recording Sounding Apparatus' of the Coast Survey. In this a weight hung from a wire wound on a reel operated by hand is allowed to drop to the bottom; the wire runs over a measuring wheel with printing attachment operating on a paper strip; a time stamp of ordinary type is placed to record on the strip close by the wheels. When the operator feels that the weight touches bottom he reverses the reel and this operation causes all the printing devices to make their records; these are correct to 0.2 foot and may be made very rapidly.

Charles K. Wead,
Secretary.

THE CONFERENCE OF NEUROLOGY AND VERTEBRATE ZOOLOGY OF CORNELL UNIVERSITY.

At the conference of the department of neurology and vertebrate zoology at Cornell University, February 7, Alfred C. Weed, '05, presented the results of his study of the Brazilian Siluridæ or cat-fishes in the museum. They were collected in 1870 by Charles Frederick Hartt, the first Cornell professor of geology and paleontology; he was a pupil of the elder Agassiz, whom he accompanied on the Thayer expedition in 1865; in 1870 he organized the Morgan expedition from Cornell University, and in 1878 died in Brazil of yellow fever. Among the numerous valuable specimens obtained by Hartt and his associates were ninety siluroids. Some years ago they were sent for identification to Professor C. H. Eigenmann, of the Indiana University, with the privilege of retaining some duplicates and describing the new species. There were found two new species, described by Kindle in 1894 as *Hassar wilderi* and *Hemiancistrus longipinnis*. Of the latter, through inadvertence, but one example was sent. In the Cornell museum, in addition to a mounted specimen that had been mounted so as to display the tufts of interopercular bristles and the tail, 'obliquely trancated, the lower lobe produced,' Mr. Weed has found two alcoholic examples; one will be sent to Dr. Eigenmann and the other to the Museum of Comparative Zoology at Cambridge.

Burt G. Wilder.

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

The fifty-eighth regular meeting of the section was held on Friday evening, February 24, in the Lowell building, Massachusetts Institute of Technology, with President Norris in the chair. About seventy-five members were present.

Mr. Charles A. Kraus, of the Massachusetts Institute of Technology, gave an experimental lecture on 'The Chemistry of Liquid Ammonia Solutions,' in which he described the solubility of various bodies in liquid ammonia which possesses a high solvent power for many substances, especially those containing carbon, with many of which it gives brilliant colored solutions. Electrolytic dissociation in ammonia solutions was discussed, and it was shown that ammonia was a much weaker electrolytic agent than water, the ions traveling 2.8 times faster in it than in the latter solvent. The alkali metals sodium and potassium are very soluble in NH_3, and the solutions conduct electricity like a metallic conductor.

Arthur M. Comey,
Secretary.

DISCUSSION AND CORRESPONDENCE.

LITERARY PRODUCTION ABOVE FORTY.

To the Editor of Science: Your making available, by quotation in the last issue of Science, the precise form of Professor Osler's much discussed 'obsessions' concerning the comparative uselessness of men above 40 years of age suggested an inquiry into the period of production in the lives of American men of letters, literature being one of the fields of achievement from which, Dr. Osler believes, we could well spare the work done by men above 40.

Even in poetry, where there might be especial reasons for the view, the case is doubtful. Bryant, indeed, wrote his most noted poems before 40, but wrote others quite as good at 70. Poe and Lanier died at 40 and 39, so their evidence is inconclusive. But Longfellow wrote 'Evangeline' at 40, 'Hiawatha' at 48, and 'Miles Standish' at 51; Whittier wrote 'Snow Bound,' his best and most characteristic poem, at 59; Whitman had done but little before his first considerable volume at 41. Lowell, alone of the more noted American poets, produced practically all of his best verse before 40; practically all of his best prose was written afterwards.

In prose, everything goes to disprove an age limit of 40. Except Jefferson's draft of the 'Declaration of Independence' (written at 33), Irving's 'Sketch-Book' (at 36), Thoreau's 'Walden' (at 37), Cooper's best novels, and, for the reason given above, all of Poe's prose, almost every notable piece of American prose was written after its author had reached 40. Some came much later—Edwards's 'Freedom of the Will' at 51, Franklin's 'Autobiography' after 51, and Irving's 'Alhambra' at 49. Hawthorne began his series of great romances with 'The Scarlet Letter' at 46. Mrs. Stowe wrote 'Uncle Tom' at 41. Mark Twain produced 'Innocents Abroad' before 40, but 'Tom Sawyer' and 'Huckleberry Finn' considerably later. Lincoln delivered the 'Gettysburg Address' at 54, Webster his 'Reply to Hayne' at 48. Prescott wrote the 'Conquest of Mexico' at 47; Bancroft's 'History' occupied him from 34 until 75. Motley wrote the 'Dutch Republic' at 42; Parkman did not begin his series of volumes on 'France and England in North America' until he was 42. The first and the second series of Emerson's 'Essays' appeared at 38 and 41, respectively. Dr. Holmes wrote the 'Autocrat' at 49, Dr. Hale, 'The Man Without a Country' at 46. John Fiske did his best work, as Mr. Stedman has done his, after 40. Mr. Howells had scarcely made a beginning of his characteristic work before 40; Mr. James had made a good beginning, but the most and the best of his works have come later.

Indeed, if one were to generalize at all from this data concerning works notable in themselves and most characteristic of their authors, the conclusion for American literature would not be that no work of the first rank had been done by men above 40, but that the period of life conspicuous for superior production was between 40 and 50, and that, as Bulwer-Lytton suggested, real maturity seldom comes before the age of 35.

Clyde Furst.

Columbia University.

PRODUCTION AND THE MODERN USE OF CARBONIC ACID.

To the Editor of Science: Referring to Science for January 27, there appears on page 151, a brief extract of a paper by John C. Minor, Jr., presented to the New York Section of the American Chemical Society on December 9. The title of this paper, as given, is the 'Production and Modern Use of Carbonic Acid.' In the abstract, however, there is no reference to carbonic acid; the paper appears to deal entirely with carbon dioxide, and I suppose this is another case of the common misuse of this term. I would suggest that you make some effort to correct this prevalent error, because if we should want to talk about the real carbonic acid, there would be no way of conveying the meaning intended, unless the chemical symbol be used, because as it is, CO_2 has monopolized for itself two names.

A. Bement.

MONT PÉLÉE?

Although nothing is commoner than instances of mistaken etymology, it rarely happens that a single name admits of so many interpretations as does 'Mont Pelée sive Mont Pelé.'

Having gone through in my own mind all the possibilities of the name, from that of the Hawaiian goddess, with which I started, to that of Pelée = bald, a good name for a bare summit, I have come at last to believe that it is simply the Gallicized form (Pélée) of the Greek Peleus, the son of Æacus and father of Achilles—*Mount Peleus* has a likely sound and needs no explanation of its gender. The form Pélée for Peleus is found in Littré.

Harris Hawthorne Wilder.

Smith College.

SPECIAL ARTICLES.

NATURAL MOUNDS OR 'HOG-WALLOWS.'

The paper of Mr. A. C. Veatch reported in Science, No. 530, p. 310, is of much interest to those acquainted with the natural mounds or hog-wallows of California and Oregon. Such mounds are especially abundant along the east side of the San Joaquin valley in California, where they cover hundreds of square miles, and extend from the valley floor, where they are most abundant, up the slopes of the foot-hills to an elevation of more than five hundred feet. The underlying rocks vary from Pleistocene gravels, sands and clays to granites, schists and folded paleozoic slates. I have never found them, however, in the sandy river bottoms. In height they range from one foot to four feet, and in diameter from ten to more than fifty feet. They are equally abundant in eastern Oregon and in some parts of the drift-covered portions of the region south of Puget Sound.

The theories usually advanced in explanation of these mounds on the Pacific coast are: (1) Surface erosion, (2) glacial origin, (3) æolian origin, (4) human origin, (5) burrowing animals, including ants, (6) fish-nests exposed by elevation.

Bearing upon the theory of ant origin mentioned by Mr. Veatch, something will be found in the *Bulletin of the Geological Society of America,* Vol. VII., pp. 295–300, and also in the *Journal of Geology,* VIII., 151–153. It ought to be noted, however, that the ant-hills of the tropics with which I am acquainted, remarkable and abundant as they are, do not much resemble the hog-wallows or prairie mounds. Perhaps, however, no great stress can be placed upon this difference. The ant-hills of Brazil vary greatly in size and form, according to the species building them and according to the soil. If it be assumed that the ants built the mounds in this country and disappeared long ago, it is to be expected that time would have greatly modified and toned down their original relief. It is, perhaps, worthy of note, and may be of interest in connection with the ant-hill theory, that in western Washington and in parts of California they are partly on glacial soils, that is, on drift or on sediments spread over the San Joaquin valley during the glacial epoch. The glacial theory of their origin suggested by the letter of Wallace in *Nature,* XV., 274, is without support—the glaciers in California did not reach the region of the hog-wallows in the San Joaquin valley.

In addition to what Mr. Veatch says of the distribution of the mounds in the Mississippi valley it may be stated that they follow up the valley of the Arkansas and of the Neosho rivers across Indian Territory into southeastern Kansas. In Arkansas and Indian Territory they are common in forests as well as in prairies.

It is supposed that sections through these mounds would explain them. In California hundreds of mounds have been cut through by railways and by common roads, and many such sections have been examined. The cuttings, being made without any special care, exhibit only a compact clayey 'hard-pan' that shows no signs of burrows or anything that has been recognized thus far as different from the soil of the adjacent areas. In the San Joaquin valley the soil of the hog-wallows is not regarded as good. In some places it is so hard that it is very difficult to plow it. In the region between the San Joaquin River and the city of Fresno the soil of these hog-wallows is mostly of quartz, feldspar, mica and hornblende, with a little clay and some iron. These materials are derived from the granites and other crystalline rocks of the mountains to the east. One section examined in a pit eight feet deep and one thousand feet north of Herndon station is spoken of in my notes as a 'hard-pan of quartz sand, clay and feldspar resembling a horizontally bedded sandstone with some clay in it.'

Similar mounds occur in many places and covering large areas over the flat prairie lands along the eastern slopes of the Andes in the Argentine Republic. I used to think the Argentine mounds were of æolian origin, but while some mounds are evidently made in this way, the explanation is not satisfactory for the great bulk of them.

Of the theories spoken of above, the ant-hill theory seems to me the most plausible, but with our present knowledge it is far from satisfactory. One other theory has been in my own mind for several years, but it is almost entirely without observations to support it, and it is, perhaps, too vague to be clearly expressed. The idea is that in soils of certain kinds long exposed to weathering agencies chemical reactions possibly take place around centers that result in the transfer of minerals in solution to and the precipitation in nuclei that are now represented by the positions of the mounds, while the withdrawal of these minerals from the intervening areas causes the depressions around the mounds. In other words, it is a theory of concretionary action on a large scale due in part to chemical and in part to physical conditions. With this theory in view I have gathered samples from beneath the hog-wallows near Fresno and others will be gathered during the coming vacation. It is hoped that chemical analyses of these samples will throw some light on the subject.

The following references to the literature may be useful to those who wish to read what has been written regarding these mounds on the Pacific coast: Le Conte, *Proceedings California Academy of Sciences,* V., 219 (1873); *Nature,* April 19, 1877, XV., 530; Wallace, *Nature,* XV., 274; Barnes, *American Naturalist,* September, 1879, XIII., 565; Turner, 17th annual report U. S. G. S., Part I., 681. To these may be added Walther's 'Denudation in der Wüste,' 377, 390. The paper by Mr. Turner contains a good picture of the mounds on the foot-hills near Snelling, California.

J. C. Branner.

Stanford University,
March 3, 1905.

NOTES ON THE HISTORY OF NATURAL SCIENCE.

OPPIAN ON FISHING.

An early work on angling, dating from the second century of our era, and possessing considerable scientific as well as literary merit, is the 'Halieutica,' in five books, by Oppian of Cilicia. Unlike most ancient writers on natural history, Oppian manifests a strict regard for truth, not only avoiding fabulous tales, but often refuting popular errors. To wide and accurate observation the author adds the charm of felicitous description, his treatment of the subject-matter being unusually graceful and animated. Concerning modes of fishing and diving, habits of marine animals and general natural history, there is much of interest to modern readers, and in former times the work was held in high esteem. Appended to the English translation, published in 1722, is a catalogue of the vernacular names of fishes mentioned by Oppian, with their common English equivalents—the latter, however, not being always accurately given. A revised *Nomenclator* of classical names of animals, with synonyms and etymology, would be gladly welcomed by modern systematists.

ROMAN ICHTHYOLOGY.

Amongst early works of interest to ichthyologists, noticed more or less fully by Cuvier in his 'History of Natural Sciences,' there are two or three Roman writings which contain numerous and valuable observations on aquatic animals. These appeal with equal force to naturalists and classicists of our own day, though the latter appear to be on more familiar terms with them.

One of these works well worthy of attention is the '*Halieutica*' of Ovid, or commonly attributed to him, a poem which has come down to us in only one third of its entirety. Names are given in this fragment of fifty-three species of fishes, most of which are tolerably well indicated by the descriptions. Cuvier remarks that but for this poem of Ovid, a number of passages in Pliny would be unintelligible to modern readers; and in the copy belonging to the Harvard Museum, formerly the property of Louis Agassiz, occurs a manuscript note by the latter, referring to Ovid's comment on fossil shells and description of man in his '*Metamorphoses.*'

Another work regarded by Cuvier as 'extremely precious for natural history' is that bearing the assumed name of the gourmand Apicius, the ninth and tenth books being especially fruitful in information. Various ichthyological notices are contained in the agricultural works ('*De re rustica*') of Columella, Varro and Cato. Apuleius is credited with having made refined anatomical dissections, and Athenæus gives descriptions of eighty-four species of fishes, arranged in alphabetical order. It may not be generally known that Cuvier himself assisted in the recension of the text of Ælian's 'History of Animals,' his collaborators being the well-known French translators of Pliny.

SUBTERRANEAN FISHES.

Lasaulx, in his 'Geology of the Greeks and Romans,' and Sir Charles Lyell, in the introductory chapter of his 'Principles of Geology,' are responsible for widespread misconception of Aristotelian views in regard to the nature and origin of fossils. Certain passages in the works of the great Stagyrite and his successor Theophrastus, are interpreted by these authors, and in their wake by students generally, as applying to ichthyic remains found in stratified rock, whereas the original texts speak only of living fishes which burrow in the mud, and are able to survive for a considerable time out of water. Thus the passages were understood by ancient commentators, and the idea that they refer to things fossil has clearly been 'read into' them by modern historians.

Lyell's statement of the matter is as follows, omitting criticisms:

> Aristotle, in his treatise on respiration, speaks distinctly of fossil fishes; and his pupil, Theophrastus, alluding to such fishes found near Heraclea, in Pontus, and in Paphlagonia, says that they were either procreated from fish-spawn left behind in the earth, or had gone astray from rivers or from the sea, for the sake of food, into cavities of the earth, where they had become petrified.

Nothing could more completely miss the sense of the original than the above paragraph. The title of Theophrastus's essay, 'On Fishes that Exist out of Water,' is alone sufficient to exclude the notion of petrified remains. Besides, we have both ancient and modern confirmation of the accounts relative to the taking of 'dug mullets' and loaches in the same localities. Pomponius Mela, it is true, rejects the reports as improbable fish stories, but Strabo, Pliny, Polybius and others corroborate them at all points; and in our own time the facts have been verified *de novo*.

What Pliny says on this matter is interesting. He mentions a kind of loach, which Cuvier thinks is identifiable with the *Cobitis fossilis* of Linnæus, and observes that it 'frequents the waters near the banks of the rivers and makes holes for itself, in which it lives, even when the water retires and the bed of the river is dry; for which reason these fishes have to be dug out of the ground, and only show by the movement of the body that they are still alive.' Nor does he omit in the same connection ('Nat. Hist.,' IX., 83) to quote Theophrastus's statement that 'in Paphlagonia, also, land fishes are dug up which are most excellent eating.'

Strabo is equally explicit in his account of the 'dug mullets' of Narbonne, long esteemed one of the principal wonders of the Keltic coast. Thus we read in the fourth book of his 'Geography' as follows:

> There is a lake near to Ruscino [on the site of which now stands Perpignan], and a little above the sea a marshy district full of salt-springs, which supplies 'dug mullets'; for whoever digs two or three feet, and plunges a trident into the muddy water, will be sure to take the fish, which are noteworthy for their considerable size; they are nourished in the mud like eels.

It is unnecessary to prolong the discussion, or to point out that the views of ancient masters in natural science have been needlessly disparaged through faulty interpretation of the original sources. We are concerned only with restoring to the latter their literal meaning. A word may be said, however, concerning the formidable array of geological doctrines attributed by Lyell, in the work quoted, to Pythagoras, of the sixth century, B. C. Of this almost mythical personage we know very little for certain, of his doctrines nothing at all. Those ascribed to him are not Pythagorean, but Stoic; not of the hoary sixth century before our era, but Augustan; not altogether Greek, but in large part Roman; and in order to form a clear historical perspective it is necessary that these facts be recognized.

C. R. EASTMAN.
HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

THE Central Branch of the American Society of Naturalists and affiliated societies are holding their third annual meeting at Chicago from March 31 to April 1. Professor John M. Coulter, chairman of the Central Branch, will deliver the annual address at the dinner on March 31. Special programs have been arranged for the zoologists, botanists, anatomists and physiologists. We hope to print abstracts of the papers, a considerable number of which are announced on the preliminary program.

IT is announced that the first John Fritz gold medal will be conferred upon Lord Kelvin. This medal is awarded by a joint committee of the American Institute of Electrical

Engineers, the American Society of Mechanical Engineers, The American Society of Civil Engineers and the American Institute of Mining Engineers to the man most representative of, and eminent in, scientific advance in the engineering field.

Previous to his departure for England, to assume the chair of medicine in the University of Oxford, a dinner will be given to Dr. William Osler at the Waldorf-Astoria, in New York City, on May 2.

Dr. H. P. Bowditch, professor of physiology at Harvard Medical School, has recently visited the universities of the Pacific coast.

We learn from *The Botanical Gazette* that Sir Joseph Hooker retired from the editorship of the *Botanical Magazine* at the close of 1904, after forty years of service. He is succeeded by Sir W. Thiselton-Dyer.

We learn from *Nature* that Professor W. J. Sollas, F.R.S., has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons of distinguished eminence in science, literature, the arts, or for public services.

Professor L. C. Herdt, assistant professor of electrical engineering at McGill University, has been awarded the honorary title of officier d'académie, by the French government.

Mr. J. E. S. Moore has been appointed director of the Cancer Research, which is carried out in connection with the Royal Infirmary.

Mr. R. R. Kelly, assistant professor in the department of engineering at the University of South Dakota, Vermillion, S. D., is resigning in order to join the staff of the Symms & Powers Company, heating and ventilating engineers, of Sioux Falls, S. D.

G. E. Coghill, Ph.D., professor of biology at Pacific University, has been elected secretary of the Oregon Academy of Sciences.

The Bakerian lecture of the Royal Society was delivered on March 23, by Dr. Horace T. Brown, F.R.S., who took as his subject 'The Reception and Utilization of Energy by the Green Leaf.'

A medal in commemoration of M. Alfred Cornu will be struck by the French Physical Society.

It is proposed to erect a memorial in Jena to Professor Ernest Abbe in commemoration of his services to optical science and industry. Subscriptions should be sent to the treasurer, Dr. Gustav Fischer, Jena.

The centenary of the birth of the Russian mathematician W. J. Buniakowsky was celebrated at St. Petersburg on December 16, and on December 29 the centenary of the birth of K. Schallbach was commemorated in Berlin.

An intercollegiate course in Appalachian Geology will be given under the direction of several instructors, as follows: July 3–8—Professor W. B. Clark, of the John Hopkins University, on 'The Tertiary and Cretaceous Strata of the Coastal Plain of Maryland.' July 10–15—Professor W. M. Davis, of Harvard University, on 'The Folded Paleozoic Strata of the Susquehanna-Juniata District of Pennsylvania.' July 17–22—Professor T. C. Hopkins, of Syracuse University, on 'The Horizontal Paleozoic Strata and Glacial Features of Central New York.' July 24–29—Professor H. P. Cushing, of Western Reserve University, on 'The Faulted Crystalline and Paleozoic Rocks of the Little Falls District, N. Y.' July 31–August 5—Professor J. Barrell, of Yale University, on 'The Metamorphic and Triassic Rocks of Western Connecticut.' This course is intended for men who have already some knowledge of general geology, including field work. The party will meet in Baltimore on Monday, July 3. The work of each week may be taken separately. It may be necessary to limit the number of members in the first week; preference will be given to those who take the entire course. A circular giving fuller details of the course can be had of Professor Clark on about March 10.

The position of chief of the Division of Chemistry, Hygienic Laboratory, Public Health and Marine Hospital Service, will be filled by civil service examination on April 26. The salary of this position is $3,200. Competitors are not assembled for examination, but will be graded for education, experience and publications. Examinations are also announced by the civil service commission on April 26–27, for forest assistants in the Bureau of Forestry, Department of Agriculture, at salaries of $1,800, $1,400 and four at $1,200; on April 12, for assistant in the Division of Biological Survey, U. S. Department of Agriculture, at a salary of $900; and on April 19, for hydrographic aids, municipal water supply, U. S. Geological Survey, at salaries of $1,000 to $1,500.

The Fourth International Ornithological Congress, under the presidency of Dr. R. Bowdler Sharpe, of the British Museum, will be held in London from June 17 to 12 inclusive. Drs. J. A. Allen, Chas. W. Richmond and Leonhard Stejneger, and Messrs. F. M. Chapman, D. G. Elliott and Robert Ridgeway represent the United States on the general committee.

We have received the official program of the second International Botanical Congress, which will be held at Vienna on June 11–18.

The fifteenth German Geographentag will be held at Danzig on June 13–15.

We learn from the *American Mathematical Journal* that the firm of J. A. Barth in Leipzig has undertaken to publish a directory, compiled by F. Strobel of Jena, of all living mathematicians, physicists, astronomers and chemists. A new edition is to appear every two years.

Replying to questions in the House of Commons, Mr. Brodrick, secretary of state for India, said that the latest figures on the plague in India showed that for the four weeks ending February 28 in the Bombay presidency there were 13,475 deaths, and that for the four weeks ending March 11 in the rest of India there were 123,550 deaths. The total number of deaths from the plague in the Bombay presidency from January 1 to February 28 were 28,721, and in the rest of India, from January 1 to March 11, 318,178. Mr. Brodrick said he had communicated with the viceroy of India, looking to a remedy for this deplorable loss of life, and that it had been decided to send out a scientific expedition to investigate the causes. The expedition will start immediately.

Mr. Arthur Erwin Brown, secretary of the Zoological Society of Philadelphia, in a recent address before the Academy of Natural Sciences said: "The 'Origin of Species' was first published in London on November 24, 1859. On March 27, 1860, Charles Darwin was elected a correspondent of the academy. On May 8 he wrote to his life-long friend, Charles Lyell: 'This morning I got a letter from the Academy of Natural Sciences of Philadelphia announcing that I am elected a correspondent. It shows that some naturalists there do not think I am such a scientific profligate as many think me here.' It appears from the record that this academy was the first among scientific societies to confer its honors upon Charles Darwin after the publication of his immortal work."

It was announced at the last monthly meeting of the London Zoological Society that the total number of visitors to the garden during the year 1904 had been 706,074, exceeding the numbers in 1903 by no less than 48,866. The receipts for admission at the gates during the year amounted to £17,063, being an increase of £1,151 as compared with the year 1903. The total number of fellows elected during the year had amounted to 249, showing an increase of 31 as compared with the previous year. The total number of fellows on the roll on December 31 last was 3,557, being the largest number ever recorded in the history of the society.

The tenth International Anti-alcohol Congress is to be held at Buda-Pesth from September 12 to 16. Among the questions proposed for discussion are: The influence of alcohol on the resisting power of the human and animal organism; is alcohol a food? alcohol and sexual life; alcohol and the penal law; alcohol and physical fitness, with special reference to military training; the organization of the temperance movement; school and education in the struggle against alcoholism; the reform of the liquor trade; and the corrupting influence of the trade in spirituous liquors on the natives of Africa.

We learn from the London *Times* that the annual meeting of the Anthropological Institute of Great Britain and Ireland was held on January 21, Mr. H. Balfour, the retiring president, in the chair. The annual report of the council stated that the year had been one of steady progress, the number of new fellows and the net increase being greater than for any year since 1898. The total membership now stood at 442. The question of physical deterioration had lately been engaging public attention, and the council had prepared a memorial to Lord Londonderry recommending the organization of an anthropometric survey and the appointment of an advisory committee, and making other suggestions. An amendment to strike out of the report a proposal that the publication *Man* should be paid for by fellows in order to assist in meeting the annual deficit was rejected after prolonged discussion, and the report was approved. The treasurer's report stated that the income from subscriptions for the past year was the highest on record. Notwithstanding this highly satisfactory increase of the institute's principal source of income, there had been an excess of expenditure over income in every year of the 1900–04 period except 1902. The chief cause of these deficits appeared to have been the increase in the cost of the annual publications. The council accordingly proposed to effect economies in their publications, and to ask members to pay for their copies of *Man*. The report was agreed to. Professor W. Gowland, F.S.A., was elected president for the current year.

UNIVERSITY AND EDUCATIONAL NEWS.

According to the daily papers the articles of agreement under which it is proposed to combine the Massachusetts Institute of Technology and Harvard University have been made public. They provide for a joint school of industrial science, to be known under the present name of the Institute of Technology, to be governed by an executive board of nine members, of which three shall represent Harvard, and to be maintained by present institute funds, augmented by the income of all funds of the Lawrence Scientific School, by three-fifths of the net income which may accrue from the Gordon McKay bequest, amounting to several millions, and by the income of all property which Harvard may hereafter acquire for the promotion of instruction in industrial science. The new institute is to occupy a site on the Cambridge side of the Charles River, near the present Stadium.

The Catholic University of America will receive a bequest of $100,000 from Miss Helen Tyler Gardiner.

Mr. Andrew Carnegie has agreed to give a $50,000 library to the Washington and Lee University on condition that the university raises an endowment of $50,000 for maintaining the new library.

Two new buildings are about to be erected for the Rensselaer Polytechnic Institute. One is for the departments of mathematics and drawing and the other for the department of chemistry. Both will be strictly fire proof. Their cost will be about three hundred thousand dollars. A motion is before the Troy Common Council to make a handsome stone approach to these buildings by extending Broadway.

The board of regents of the University of Michigan at its February meeting voted to invite bids for the erection of an addition to the physical laboratory according to plans already prepared.

A bill has passed the North Dakota legislature creating a state bacteriologic and pathologic laboratory, to be located at the State University and School of Mines, and to be under the control of the university trustees and the professor of bacteriology at the university, who is to be the director.

It is announced that the Russian Ministry of Public Instruction will at once undertake the elaboration of a plan for a compulsory system of primary education. Representatives of the schools in the principal cities are invited to participate in the drawing up of the plan.

George V. N. Dearborn, Ph.D., M.D. (Columbia), has been promoted to the full professorship of physiology in the Tufts College Medical and Dental Schools.

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*THE MUTATION THEORY OF ORGANIC EVOLUTION.**

The Mutation Theory of Organic Evolution, from the Standpoint of Animal Breeding: W. E. CASTLE, Assistant Professor of Zoology, Harvard University.

The mutation theory, as I understand it, is not designed to replace Darwin's theory of natural selection, nor is it capable of replacing that theory. Natural selection must still be invoked to choose between different organic forms, preserving the more efficient, destroying the less efficient. The question raised by this new theory is, What sort of forms are subjected to the action of natural selection? Is there a complete gradation of forms between two extreme conditions and is natural selection called upon to choose from this whole series the one which is organically most efficient, or is the task simpler and is the choice made merely between two widely separated conditions of the ideal series? Thus, we find within a species two varieties, one larger than the other. Have they diverged by gradual cumulation of minute differences in size, or by a single step? These alternative views are known, respectively, as the selection theory and the mutation theory. Both views were recognized by Darwin as possibilities, though he seems to have attached more importance to the process of gradual modification. Most of his followers have given attention exclusively to this process, but a few, like Bateson and de Vries, have regarded modification by

* Six addresses given before the American Society of Naturalists at Philadelphia, December 28, 1905.

steps as the more important process, if not the only one efficient in the formation of new species. Bateson ('94) has called modifications of this sort discontinuous variations, but de Vries (:01–:03) calls them mutations, and the latter designation seems likely to be generally adopted.

Darwin rightly attached great importance to the variations of domesticated animals and plants as throwing light on the origin of species. He recognized that there is no essential difference between breeds and species, and that if we can ascertain how breeds originate we can infer much as to the origin of species. He made an extensive study of breeds of animals as well as of plants, but no one has followed this up or even recognized its great importance until within very recent years. What we need to know is how, precisely, are new breeds formed. We know that they are forming under our very eyes all the time and that this has been going on since the earliest historic times and no doubt a great deal longer, yet the method eludes us.

The successful practical breeder, the man who originates breeds, is a keen observer, a man of unusual intelligence and skill and of infinite patience. Yet if we ask him how, in general, he does his work, or how a particular result was obtained, we rarely get a satisfactory answer. This is sometimes because, for commercial reasons, it is well to leave a cloud of obscurity surrounding the origin of a successful breed, lest its production be duplicated. More often, however, it is because the breeder himself does not know how the result was attained. He may be able to tell us that such and such animals were mated, such and such of their offspring selected, and after a certain length of time the breed was established and put on the market. But this, after all, gives us little information as to the real nature of the material used and the processes involved in the formation of the new breed. The aims of the biologist are so different from those of the practical breeder that to solve the theoretical problems involved in the formation of breeds the biologist must himself turn breeder, and see new organic forms arise out of material with which he is thoroughly familiar, and under conditions which he can control. So little work of this kind has yet been done that its fruits are scarcely ready to be gathered. Generalizations can as yet be made only tentatively, based on cases dangerously few, or on the rather uncertain and often contradictory testimony of practical breeders and the half-truths told by stock registers.

So far, however, as these various sorts of evidence go, they indicate that the material used by breeders for the formation of new breeds consists almost exclusively of mutations. The breeder does not set to work with some purely imaginary form in mind, toward which he seeks by selection gradually to mold his material. He commonly either *discovers* the new breed already created and represented by one or more exceptional individuals among his flock, or else he seeks by cross-breeding to combine in a single race characters which he finds already existing separately in different races. In both cases he deals with mutations, *i. e.*, with characters unconnected by a series of transition stages with the normal form. An illustration from my own experience may help to make this clear. A little more than four years ago I obtained a number of ordinary smooth-coated guinea-pigs and began breeding them with a particular experiment in mind. Among nine young produced by a certain pair, there was one which had a supernumerary fourth digit on one of its hind feet. Neither of the parents had such a digit, nor had I ever heard of the existence of such a character before, either in any of the wild Caviidæ, or among domesticated cavies or guinea-pigs. Further, I have been able to find no reference to such a thing in the literature of the group, though I have several times since found this same mutation in other herds of guinea-pigs. The mother of my four-toed pig never produced another similar individual, though she was the mother in all of thirty young. The father, however, who sired in all 139 young, had five other young with extra toes, but these were all by females descended from himself, so that it seems certain that the mutation had its origin in this particular male. By breeding together the four-toed young and selecting only the best of their offspring I was able within three generations to establish a race with a well developed fourth toe on either hind foot. This race was not *created* by selection, though it was *improved* by that means. Like the poet, in the proverb, it was *born,* not made. Any amount of selection practised on other families of my guinea-pigs would probably never produce a four-toed race, for though carefully watched through as many as seven generations no four-toed pig has appeared among them.

In a second family of my guinea-pigs, which, like the other, was for the purpose of a particular experiment inbred, a different mutation made its appearance. A few individuals were found to have hair about twice as long as that of their parents and grandparents. Intermediate conditions did not occur. Long-haired individuals mated together were found to produce only long-haired young, so that a new breed was already fully established without the exercise of any selection. It was found, in short, that the long-haired character is a Mendelian recessive in relation to the normal short coat, so that matings between long-haired and short-haired animals produce only short-haired young. But these young bred *inter se* produce a definite proportion (about one fourth) of long-haired young, and if no selection is practised among their offspring, but all are allowed to breed freely, the race will continue to contain this proportion of long-haired individuals.

If such a mutation as this occurred in a state of nature, and such a possibility we can scarcely question, a dimorphic species would be the immediate result, containing two varieties alike in every respect except length of hair, in which they would be sharply separated. The two varieties would coexist in the same habitat and might continue to interbreed freely without the destruction or necessary modification of either. Natural selection would now come into operation to choose between the two that one which was more advantageous and the other condition would be gradually eliminated from the race. Or if the two conditions were each the better in a different habitat, then by the gradual destruction of the other in that habitat the two varieties would become geographically separated, though they might continue to coexist in an intermediate zone.

The second method which I mentioned for the artificial production of new breeds is to combine in one race characters already found in different races. This is accomplished through cross-breeding and is made possible by the facts (1) that mutations are alternative in heredity to the normal condition, and (2) that one mutation is entirely independent of another in heredity. If, for example, we cross long-haired with short-haired guinea-pigs, we get, among the second-generation offspring, a mixture of long-haired and of short-haired animals, but, as a rule, no intermediates. Further, if in the original cross one parent was four-toed and the other three-toed, then in the second generation offspring we get all possible combinations of the characters involved in the cross, viz., long-haired four-toed animals, long-haired three-toed, short-haired four-toed and short-haired three-toed. From this array of forms the breeder may now select the particular combination of characters which suits his purpose.

Can we doubt that in nature a similar choice is offered between every mutation and its opposite, combined or uncombined with every other mutation then present in the race?

It is true that cross-breeding may affect to a greater or less extent the nature of the characters involved in a cross, but this sometimes facilitates the creation of desirable breeds, for it serves to induce new mutation, which in some cases is progressive, in others regressive. For example, in guinea-pigs, a cross between a coal-black animal and an albino may restore in the young the ancestral, or 'agouti,' coat consisting of black hairs ticked with reddish yellow, or in other cases may result in the production of a black-white spotted animal. By selection either of these conditions may be perpetuated in a distinct breed. The one is a regressive or reversionary change, the other progressive in that it leads to the production of a new type of pigmented coat.

On the whole, it appears that the formation of new breeds begins with the discovery of an exceptional individual, or with the production of such an individual by means of cross-breeding. Such exceptional individuals are mutations.

An examination of stock registers points in the same direction. The beginnings of new breeds are small. Pedigrees lead back to a few remarkable individuals or to a single one, as in the Ancon sheep. But given the exceptional individual, and a new breed is as good as formed. The few generations which the breeder usually employs in 'fixing' or establishing the breed and during which he practises close breeding serve principally to free the stock from undesirable alternative characters, not to modify the characters retained.

Modification of characters by selection, when sharply alternative conditions (*i. e.*, mutations) are *not* present in the stock, is an exceedingly difficult and slow process, and its results of questionable permanency. Even in so-called 'improved' breeds, which are supposed to have been produced by this process, it is more probable that the result obtained represents the summation of a series of mutations rather than of a series of ordinary fluctuating variations. For mutations are permanent; variations transitory. A moment's reflection will indicate the probable reason. Variations which are distributed symmetrically about a modal condition, so as to produce when graphically expressed a frequency of error curve, represent the result of a number of causes acting independently of each other. These causes are principally external, consisting in varying conditions of food-supply, temperature, density, moisture, light, etc. These conditions alter from generation to generation, and so do effects dependent upon them. Mutations, on the other hand, have an internal origin, in the hereditary substance itself. They are relatively independent of the environment, being affected only by such causes as affect the nature of the hereditary substance itself, one of which apparently is cross-breeding.

There are, however, frequently found in breeds of domesticated animals conditions which are *not* sharply alternative in heredity to the corresponding characters of other breeds. It is an open question whether such conditions could be maintained if cross-breeding were freely allowed with animals of a different character. If not, they could scarcely become racial characters, under the action of natural selection. The race would then become, not sharply dimorphic or polymorphic, as is the case where inheritance is sharply alternative, but subject to extremely great fluctuating variations. It is open to question whether blending characters of this sort found in many breeds may not have been created by selection from masses of fluctuating variations. It will be important to know further whether or not these extreme fluctuating series have had their origin in mutations. Not improbably, as de Vries has in part suggested, one-sided variation curves indicate the occurrence of mutations of this sort.

The Mutation Theory From the Standpoint of Cytology: Edwin G. Conklin, professor of zoology, University of Pennsylvania.

I. The mutation theory is founded upon the idea that mutations are primarily germinal, that they arise in one or both of the sex cells and only later appear in the adult organism. In contradistinction to certain theories of evolution which are concerned chiefly with the modifications of adult structures, the mutation theory is primarily concerned with modifications of the germ, and here it comes into direct relation with the science of cytology.

De Vries tells us that the foundations of the mutation theory were laid in his doctrine of intracellular pangenesis. Like Darwin, Galton, Weismann and many others, he recognized the fact that the method of evolution is at bottom a problem of inheritance and that, in the words of Osborn, 'When we have reached a heredity theory that will explain the phenomena of inheritance, the method of evolution will itself be a thing of the past.'

It seems like a mere truism to affirm that the evolution of animals and plants must be accompanied by an evolution of their germ cells, and that the principal problem of evolution is not how modifications are produced in adults, but how they arise in the germ. And yet with few exceptions previous theories of evolution have concerned themselves only with the transmutations of adult forms and have paid no attention to the modifications of the egg or sperm or embryo. The mutation theory is a theory of the evolution of organisms through the evolution of their germ cells and it is, therefore, founded primarily upon cytological phenomena.

An antecedent objection to any such theory is the very general opinion that the germ cells are composed of 'simple, undifferentiated protoplasm' and that they do not contain specific morphological elements upon which evolutionary forces might act. However, such a view is supported neither by observation nor by the latest and most careful experiments. We know that the cell is vastly more complex than was assumed a few years ago, and there is no good reason for supposing that all of its visible structures are now known. The fact that fragments of eggs may in some instances give rise to entire embryos does not necessarily imply, as is usually assumed, that the egg is undifferentiated. In eggs, as in adult forms, the degree of differentiation may be largely independent of the power of regeneration or regulation, and certainly such experiments do not nullify the most positive and direct evidence, drawn from many sourees, as to the complexity of the germ.

Extensive studies which have been made upon the structure of the nucleus have brought to light a degree of organization in this part of the cell which was wholly unexpected. It has long been known that in any given species the number of chromatic threads or chromosomes in the nucleus is constantly the same in all kinds of cells, except in the last stages of the formation of the sex cells, where the number is one half the normal; in the union of the egg and sperm nuclei in the fertilization the normal number is again restored. Van Beneden, Boveri, Hertwig and others have shown in the most convincing manner that these chromosomes are the principal seat of the material substance concerned in hereditary transmission, and recently Boveri has determined that the several chromosomes are individually different in the heritable qualities which they bear. Coincidently with this notable discovery Montgomery found that the reduction of the number of chromosomes in the sex cells is effected by the union of chromosomes into pairs and he showed good reason for believing that one member of each pair came from the father and the other from the mother. This conclusion was confirmed and extended by Sutton, and he, as well as others, pointed out the suggestive fact that in the maturation divisions immediately preceding the formation of the ripe egg or sperm only one chromosome of each pair goes into each mature germ cell. This parental purity of individual chromosomes in the sex cells corresponds to the purity of parental characters in the experiments of Mendel and the chance combination of these chromosomes into pairs in fertilization corresponds with the combinations of qualities (the Mendelian ratio) in alternate inheritance. These remarkable discoveries as to the organization of the nucleus demonstrate that the germ cells are by no means simple and undifferentiated, as has often been affirmed, but rather that they contain numerous visible morphological elements, each of which has a particular rôle in hereditary transmission, and they suggest that modifications of these elements, however produced, are the real causes of evolution.

Much work has also been done upon the differentiations of the cytoplasm in the egg cell (obviously the sperm is unsuitable for such a study); with few exceptions the earlier experimental work led to the conclusion that the cell substance was isotropic and undifferentiated. However, many careful observations have shown that in the case of many animals the cytoplasm is visibly differentiated in certain areas of the egg and that the substances of these areas give rise in the course of development to particular organs or parts of the embryo. It is now known that in the eggs of a considerable number of animals belonging to several different phyla all the axes and planes of symmetry of the future individual are marked out in the unsegmented egg, and in the case of certain annelids, mollusks, echinoderms and ascidians it has been discovered that the substances of the ectoderm, the mesoderm and the endoderm are visibly differentiated in the egg before cleavage begins. In certain ascidians I have found that all the principal organs of the larva, viz., the muscles and mesenchyme, the gastric endoderm and general ectoderm, the nervous system and notochord, are all represented in the two-cell stage by visibly distinct substances which are definitely localized in the egg. These facts show that in certain groups of animals there is such a thing as a morphology—not merely a promorphology—of the ovum and they demonstrate that there are morphological elements in the cytoplasm upon which evolutionary forces may act.

It is a matter of prime importance to know whether the nucleus contains the only hereditary material carried over from one generation to another or whether certain characters, such as polarity, symmetry and the localization of organ bases in the egg, may not have their seat in the cytoplasm. It is as yet too soon to make any positive assertions on this point but the evidence seems to favor the view that the nucleus is at least the principal seat of the inheritance material. Even in cases where the cytoplasm of the egg is so highly differentiated as in ascidians this conclusion probably holds good. The three principal kinds of protoplasm of the ascidian egg before cleavage are the ectoplasm which gives rise to ectoderm, the mesoplasm which produces mesoderm and the endoplasm which becomes endoderm. Each of these three substances is derived in part from the nucleus of the egg; the ectoplasm comes from the egg nucleus at the beginning of the first maturation division, the other two from the nucleus at an earlier stage in the ovogenesis. In every cycle of division a large amount of chromatic material escapes from the nucleus into the cytoplasm and I have found in mollusks and ascidians that this substance is then differentially distributed to different areas of the egg and that it gives rise in part to the principal formative substances of the embryo. These facts lend support to the hypothesis of intracellular pangenesis proposed by de Vries; they show that even though a certain number of general differentiations may be transmitted through the cytoplasm, such as polarity, symmetry and localization, nevertheless the mechanism exists for the nuclear control of the cell and they thus afford a means for harmonizing the facts of cytoplasmic organization with the nuclear inheritance theory.

We find, therefore, that the germ is by no means simple, even if we consider only the visible structures of the cell, and that its organization is sufficiently complex to exercise a determining influence upon development and evolution. Similarities in the character and localization of the material substances of the egg must be the initial causes of all similarities or homologies which appear in the course of development. Modifications of this germinal organization, however produced, are probably the immediate causes of evolution.

II. If we inquire how such modifications of the germ arise and what the particular modification is which is associated with a certain mutation of the adult organism, we pass from the region of observed fact to one of hypothesis, for in only a few instances have such germinal mutations been observed. Nevertheless, enough is known regarding the organization of the germ cells to warrant our hazarding a 'shrewd guess' as to the nature of these germinal mutations. The nuclear inheritance theory points to some modification in the structure, number or distribution of the chromosomes or of the elements of which the chromosomes are composed as the initial cause of mutation. The fact that the Mendelian ratio in alternate inheritance corresponds to the ratio of chromosomal distribution in the maturation and fertilization of the egg indicates that in such chance distribution of these chromosomes we have the principal cause of the law of alternate inheritance, as Wilson, Sutton, Cannon and others have pointed out. It may also be reasonably inferred that in this chance distribution of chromosomes we have one of the most potent causes of individual variations.

It is well known that the disappearance of characters does not necessarily imply their final loss; many heritable qualities remain latent through one or more generations, only to appear as active characters in subsequent generations. In such cases it is probable that the material bearers of these qualities also remain latent, though we are wholly ignorant of what constitutes latency as contrasted with activity in chromosomes.

Relatively little is known as to the factors which determine the number of chromosomes or as to the effect of varying numbers on adult organization. Montgomery concludes from his studies on the Hemiptera that certain chromosomes are in the process of degeneration and disappearance in these animals. In this case the heritable qualities which were borne by these chromosomes would also disappear, thus constituting a case of 'regressive mutation' in the terminology of de Vries. In other cases there has evidently been an increase of chromosomes in some species as compared with others; though whether this increase is due to the division of originally single chromosomes, or to the addition of new ones through abnormalities of division or distribution, or through hybridization, can not now be determined. Irregularities in the number and distribution of chromosomes are by no means uncommon and in the case of hybrids are very frequent, as has been shown by Juel, Guyer and Cannon. By an increase in the number of chromosomes or in the number of elements of which a chromosome is composed the sum of the heritable qualities would probably be increased, thus constituting, in the language of de Vries, a 'progressive mutation.' There is no evidence and no probability that new chromatic elements are ever added to the nucleus from the cytoplasm, or that they ever arise *de novo*. Such new elements must arise through new combinations of old elements, either, as de Vries considers, by an actual interchange of Anlagen (material particles) between the pairs of maternal and paternal chromosomes, or, as Haecker supposes, by an interchange of grandparental parts of chromosomes, or through hybridization or irregular mitoses. Guyer has shown that the divisions of the chromosomes are frequently or usually irregular in hybrids and he suggests that such irregular mitoses may add or subtract certain chromosomal elements and thus constitute the basis for a mutation. Such cases are, however, almost entirely hypothetical and at present we are compelled to admit that we do not know how mutations arise or first become manifest in the chromatin.

As regards the cytoplasm, I have shown reason for believing that it is composed in part of escaped nuclear material and that the mechanism, therefore, exists for the nuclear control of the entire cell. The organization of the cytoplasm is chiefly manifest in its polarity, symmetry and the localization of unlike substances. There are reasons for believing that many bilateral animals are characterized by fundamental similarities in the polarity and symmetry of the unsegmented egg; the types of localization of organ bases are, however, very different in different phyla; in particular the localizations in the eggs of ctenophores, nemerteans, echinoderms, annelids, mollusks and ascidians are thoroughly characteristic of each phylum, and except in the case of the annelids and mollusks there are few similarities between these types. Nevertheless, it is possible that certain of these types may have been derived from others; in fact, such transformations might be accomplished far more easily in the egg than in the adult.

Despite the evident and almost insuperable difficulties involved, certain zoologists have not hesitated to indicate how the adult form of one phylum might have been derived from the mature form of another; thus we have the cœlenterate, the nemertean, the echinoderm, the annelid and the arthropod hypotheses as to the origin of the vertebrates, and in each of these cases by stupendous transformations, degenerations and new formations of the adult form of the invertebrate in question the vertebrate is supposed to have sprung into existence fully formed and panoplied, like Minerva from the brain of Jove. In all these speculations fancy occupies so prominent a place and facts are so scarce that it is no wonder that the whole 'phylogeny business' has come into disrepute. Nevertheless, the evolution idea compels us to assume that there are relations more or less remote between all phyla and that some must have come from others by natural processes.

Without attempting to defend any of the hypotheses mentioned it may here be pointed out that relatively slight modifications in germinal organization would convert one type into another.

A distinguishing characteristic of the mutation theory is the recognition of elementary characters or properties which manifest themselves in many separate parts of the adult, as, *e. g.*, the presence or absence of hairs or certain colors; if mutations are germinal the widespread distribution of such characters in the adult are easily explained. Relatively slight modifications of the germ, however produced, may lead to profound and widespread modifications of the embryo and adult. I have elsewhere shown reason for believing that the cause of inverse symmetry which occurs regularly among some species and occasionally among all, man included, is to be found in the inverse organization of the egg, and that this inverse organization may be due to the maturation of the egg at opposite poles in dextral and sinistral forms. This case shows that one of the most remarkable and far-reaching forms of variation with which we are acquainted is the result of relatively slight alterations in the localization of germinal substances in the unsegmented egg.

One of the principal difficulties in explaining the origin, on evolutionary grounds, of different phyla has been the dissimilar locations of corresponding organs or parts. These difficulties are well illustrated by the theories which attempt to derive the vertebrates from the annelids, or from any other invertebrate type. If evolution takes place through transformations of the germ rather than of the adult, it is no more difficult to explain the different locations of corresponding parts in these phyla than their different qualities. Changes in the relative positions of parts which would be absolutely impossible in the adult, may be readily accomplished in the unsegmented egg, as is shown by cases of inverse symmetry. The question is here raised whether some similar sudden alteration of germinal organization may not lie at the basis of the origin of new types.

Mutations: Thomas Dwight, Parkman Professor of Anatomy, Harvard Medical School.

It has been clear from the beginning that evolution, if it be a power at all, must work either by minute modifications or by more or less sudden changes. Darwinism is essentially the doctrine of minute modifications increased by selection and controlled by the survival of the fittest. Darwin insisted most strongly on the importance of minute modifications. While holding that 'strongly marked variations' might modify a species without the help of any selection at all, he absolutely denied any sudden changes of importance such as lie at the bottom of the mutation theory. 'Natural selection,' he wrote, 'acts only by the preservation and accumulation of small inherited modifications'; and he asserted that it would 'banish the belief of the continued creation of new organic beings or of any great and sudden modifications of their structure.'

The mutation theory of sudden jumps and, it may be, of long jumps, is far from new; but it is de Vries's merit to be able to show by demonstration what before was only theory. His hypothetical 'pangens' by which the changes are said to be brought about need not be discussed here. A radical difference between the two theories is this: Darwinism pure and simple is essentially fortuitous; it aims in no particular direction, there is no goal; while mutation by producing suddenly a new species, or at least a subspecies, implies the existence of a type and of a law which under certain conditions becomes operative.

In this discussion the anatomist is at a disadvantage to the botanist and the breeder who can experiment. His argument must be largely analogical. He must consider how anatomical observations, both on races and on individuals, are better explained by one theory or the other. Man's body, for I am speaking as an anatomist and leaving aside all consideration of psychology, man's body, as we find it to-day, does not mutate, but varies. What do the variations tell us? Race anatomy offers many instances of fusion of different races and occasionally suggests the occurrence in the past of a race differing sharply from those around it. Perhaps the best example of a race without approximate relations and most indicative of mutation is that of the pigmies. On the whole, race anatomy tells us little. What we call race characters occasionally appear sporadically where one would not expect them. Thus the Mongolian spot on the sacral region of infants has been recently observed on a child in Bavaria. More or less striking features of the disputed Neanderthal race occur among us. The study of anatomical variations in the dissecting rooms of different parts of the world shows that while in all probability there are different tendencies in different races, the variations themselves are of no practical importance. Thus the palmaris longus is absent in 12.7 per cent. at St. Petersburg and in 40.4 per cent. at Strassburg. The 'candelabra' method of division of the carotid artery occurs in 20 per cent. at Strassburg and in 60 per cent. at Breslau. The average absence of the pyramidalis is 12.7 per cent. at Strassburg, 21 per cent. in Massachusetts, while among the Japanese this muscle is wanting in only 3.5 per cent. I have found the psoas minor absent in 60.5 per cent. against 48.7 per cent. at St. Petersburg. The sternalis, so exceptional in Caucasians, occurring at most in from 3 to 4 per cent. was found in nearly 9 per cent. of the Japanese and certain observations on the living seem to show that a larger series would produce even a much larger proportion. This, together with the rare absence of the pyramidalis in the Japanese, points toward specialization in muscle, a feature which strikes one as in keeping with the characteristics of that race. We are familiar with the fact that there seems to be a certain similarity of character among themselves in the fauna of isolated countries, yet it surprises us to find it manifested in the deeper structures. Hrdlicka has observed a form of human tibia, suggesting that of the gorilla, in over 10 per cent. of African bones, which is almost unknown among the whites and not found at all among the Indians. Yet no one seriously believes that the negroes have any special relationship with the gorillas. This phenomenon of similarity, therefore, implies some agency beside selection.

Leaving race anatomy let us see whether the variations, which we continually observe in the dissecting room, point either one way or the other in this discussion. The theory of change by minute variations receives no support from anatomical observations. Precisely what many thought an illustration of Darwinism is its refutation. Huxley foresaw this when he doubted whether variations might not prove a two-edged sword. The fundamental error into which supporters of evolution by selection are logically driven is the unwarranted assumption that similarity of structure can be explained only by descent. Though not formally stated, this is tacitly accepted almost as an axiom.

The student of variations is oppressed by their multiplicity. Those of the biceps, for instance, are bewildering, presenting forms normal in many orders of mammals and which refuse absolutely to be forced into any line of descent. Some, indeed, are mutually contradictory. It is no more than a truism to say that if an anomaly is to be explained by reversion the structure in question must have been normal in some ancestor; but in view of the vast number of anomalies, we are forced to believe that this ancestor must have been a museum of anatomical curios of the most diverse natures. It is overlooked that if the explanation of a reversion be true it must apply not to one only, but to every possible deviation of structure that is not pathological. Phylogeny must show nothing in the history of the supracondyloid process, for instance, which will not accord with that of the paroccipital process, or with that of the third trochanter, or with that of each and all of the hundreds of variations which the human body may present. Not only has this accord not been shown, but obvious contradictions have been neglected. An explanation has been sought by referring certain peculiarities very far back: even to a hypothetical common vertebrate stem antedating the classes. We admire the learning and the research; but does the explanation explain?

One of the great difficulties of selection has been to account for the appearance of strikingly similar adaptations or arrangements in species from entirely different lines of descent. Analogous to this is the similar irregular appearance of variations. The fossa prænasalis is a deep, sharply marked depression just below the nasal opening, occurring chiefly in low races. It is not to be confounded with the gradual passage of nose into face which is the rule among mammals. I am not aware that it is found among mammals except in the seal, and even there it is less well defined than it may be in man. Here, then, is a sudden change not atavistic and certainly not progressive. The pronator quadratus in man very rarely sends a prolongation to a carpal bone. I have found this as a variation in a chimpanzee, and Macalister in a lion, but in no mammal is it normal. To find it also in turtles and in the *Cryptobranchus japonicus* does not help us much towards an explanation.

It is very suggestive that in certain variations of the platysma by which it enters into various combinations with the facial muscles, in some cases its fibers are in direct continuity with those of muscles which comparative anatomy teaches belong to another layer. It seems as if nature were striving for a certain effect and is absolutely indifferent by just what means it is accomplished.

One of the most significant points of the mutation theory is that it rehabilitates species with its old-time dignity. Though we flounder in our definitions of species, we can not get rid of the thought that it is something, after all. By a strange paradox it is precisely through variations that the tendency towards stability of species is emphasized. In my observations on the human spine I have found that very frequently the effects of a variation in one part are felt in remote parts and, indeed, throughout the spine. Some of these seem directly teleological, others tend to preserve the type. Thus if the last ribs are very small, and this holds good whether they be the normal twelfth pair or the abnormal thirteenth, the rib before the last is usually exceptionally long. In the case of cervical ribs it is common to find the last rib very small, as if the whole thorax had moved up. In cases where there are only eleven thoracic vertebræ not rarely an increase of their size tends to preserve the proper proportions of the thorax. In the lumbar region there are certain striking characteristics in the spread and in the structure of the last three transverse processes which give a definite shape to the whole region. In many cases of numerical variation there is an evident effort to reestablish normal features as nearly as the modification will permit.

It is to my mind impossible to find any support for a theory of evolution by minute changes from the study of anatomical variations. I should not venture to say, on the other hand, that they give any direct support to the theory of mutation; but at least they are not in disaccord with it.

Systematic Work and Evolution: L. H. Bailey, Director of the College of Agriculture, Cornell University.

Every object of which we take cognizance must be named if we are to record and convey the ideas associated with it. As the names accumulate, it is necessary that we group them, or provide some scheme of arrangement. We classify all categories, even though we do no more than to arrange them alphabetically. Nomenclature and classification are primary intellectual processes.

The number of organisms that we know has come to be legion. These organisms are described in books. The first descriptions accepted the organisms as they are, without serious inquiry of their origins. Definite names have come to be attached to each kind of organism and definite customs have arisen to control the bestowal of the names. Biological nomenclature has become a rigid bibliographical method.

The first object of classification was to afford a perspicuous arrangement of facts. The facts must be pigeon-holed, else they may be lost. Gradually, however, the idea of relationship between the objects has developed, and these ideas have expressed themselves in crystallized schemes of classification. That is to say, classification of organisms is a combination and compromise of bibliographical method and expression of relationships.

Presently, the organisms themselves began to be studied from the physiological side. It was discovered that at least some of the named groups of organisms are not entities. There are all grades of differences, from those peculiar to one individual to those peculiar to many individuals, and to groups of individuals. The organisms are multifarious and elastic, but nomenclatorial and taxonomic systems are editorial and arbitrary.

We are all now committed to the evolution philosophy as a working hypothesis. The greatest problems in the study of organic nature are the determining of the lines of ascent and the means by which they have come about. We study plastic material; at the same time we are making a desperate effort, at least on the botanical side, towards rigidity of nomenclature. Our ideas of what constitutes species and varieties are free and extensible enough, but our methods of designating these ideas still follow the formalism of a century ago —are in fact more inflexible than they were in the time of Linnæus. If nomenclature is inelastic, schemes of classification within the genus or species must likewise be inelastic, for the classification is but an expression of our ideas of the relationships of the objects that we name. Our nomenclature does not express either the knowledge or the point of view of our time.

The Present Status of Systematic Work. —There are three elements in the discussion of systematic work as related to transmutation theories: (1) The idea of a species, (2) the methods of naming and recording, (3) the classificatory schemes themselves.

It would be profitless at this time to enter into a disquisition as to what a species is. The many discussions of this subject are so many admissions that no one knows. The only point I care now to make is that we all recognize the fact that the single word 'species' covers groups of widely different grades of value, of differentiation, and of evolutional development. This fact has been brought forcibly to our attention again by the stimulating work of de Vries. There are collective species, elementary species and other grades. Our formal nomenclature in practise recognizes only two grades—'species' and 'variety,' with no two persons agreeing which is one or the other. If there are such differing grades in nature, then we must accept the fact and adopt new technical words for the various grades. This has not been done, at least not in practise, because we have not yet sufficiently clear ideas to enable us to do so. These varying grades of species and varieties are the results of processes of evolution, and some, if not all, of these processes are still in operation. Therefore, the new definitions of species-concepts must rest on physiological or functional grounds, not merely on morphological and anatomical grounds.

Many of us feel that the present methods of nomenclature and description will be outgrown, for these methods are made for the herbarium and the museum, rather than for the field. It is a most suggestive commentary that the botanist may know the 'species' when it is glued on an herbarium sheet, but may not know it when growing. The nurseryman or gardener may know it when growing, but not when it is in a herbarium. This is not merely because the botanist is unfamiliar with the field, or the gardener unfamiliar with the herbarium; these men have different fundamental conceptions of what a species is; they use different 'marks,' one morphological, the other largely physiological. I believe that the gardener is nearer the truth. I recall a characteristic remark made by my master, Sereno Watson, when, in the confidence of youth, I asked whether a certain binomial would be accepted a hundred years from now. He shrugged his shoulders and said quietly, 'I don't know; they may call plants by numbers then.'

I have no intention of proposing any new plan of nomenclature—that would only amuse you. I merely feel, as you do, that a change is imminent. Perhaps we shall hold to our main species-groups for history's sake, and then designate minor groups in terms of their qualities. If we find it to be true that there are fluctuating varieties and mutations of differing geneses, then we must assuredly represent these facts in nomenclature and taxonomy. Very likely we shall adopt a scheme wholly different from the current binomial plan for designating one or the other, or perhaps both. We may adopt quantitative names—having determined the main lines of differentiation, may express each variation in names of more or less. I look for some such method to result from the statistical quantitative study of variation. Let me draw an illustration also from plant-breeding practise. The horticulturist and the agriculturist have been holding to the formal or conventional idea of 'variety.' We will suppose that the farmers of a region have grown Jones's Giant White Corn. They have bought and sold and planted this name. They have fed it to the pigs; and the pigs may have thrived or may not, according as the corn contained much or little food value. The name is of no value to the pigs; and, in fact, it is of no real value to the farmer unless it is a guarantee of some particular excellence. Now, the name Jones's Giant White designates corn of certain color and shape of ear and of kernel—features which really mean nothing to the farmer, whereas the starch-content or the protein-content may mean everything. The new plant-breeding does not try to produce a new 'variety' so much as a series of generations that shall have greater efficiency. We shall have, perhaps, fifteen per cent. protein corn, or seventy-five per cent. starch corn. The name will be of no particular consequence.

If organisms are to be recognized on their merits, then we must cease to class some forms as 'natural' and others as 'artificial.' In the future, the products of the breeder and the plants of the garden are to find their rightful place in systematic plans. They illustrate processes of evolution; and if these processes are hastened by man, the products are all the more worthy of consideration in man-made schemes. The old-time distinction between native forms and domestic forms is arbitrary, unnecessary and pernicious. All animals are animals and all plants are plants.

If we are to designate minor groups or differences in terms of their real qualities, you will still ask how it can be done as a matter of practise, how we shall be able quickly and clearly to determine what particular animal or plant we have in hand. This is really a part of the problem—how to express our ideas without confusion. In the first place, I should say that the change in point of view will come slowly and we shall work out the means as we proceed. I desire only to suggest the direction in which progress seems to lie. In the second place, I should say that in the future we may care less for merely naming a thing than we have in the past—perhaps our formal nomenclature may well stop with characters that are gross and evident. In the third place—and this is the real crux of the matter—I should say that formal nomenclature must never stand in the way of our expressing the full truth about organisms. At best, nomenclature is a makeshift. It is a secondary consideration. If this statement is not accepted, then the only alternative is to say that systems of nomenclature and classification belong to one realm and that biological studies belong to another, and that, therefore, these systems can not be expected to conform to our expanding knowledge. This position would be untenable from the fact that classification is always re-adapting and re-shaping itself to our changing points of view; and nomenclature can not be wholly divorced from taxonomy. Taxonomy represents a progressive effort; nomenclature a conservative effort. Our current phytographic and zoographic methods do not allow us to express our ideas of species.

Every systematist knows how unsatisfactory the mere 'determining' of species is. It consists mainly in matching certain arbitrary characters or marks with similar marks of specimens in the 'collection.' We may have no knowledge whether these marks have any significance in the physiology or phylogeny of the species, that is, whether they are really of any biological value. In theory, we try to hold the systematist to what we call consistency in the determining of species; but as a matter of fact the systematist is constantly changing his mind as to the values of diagnostic marks—and herein, it seems to me, lies the safety of systematic work. A few years ago a botanist sent me a plant to name. When I had returned the name he upbraided me by saying that he had sent me the identical plant the year before and I had then given it another name. I replied that it was his own fault, for he had no business to send me the specimen twice.

The question really comes to this—Shall we know two kinds of species, one of taxonomy and one of biology? If so, then it is scarcely worth while to try to construct any scheme of taxonomy that shall endeavor to express our latest ideas of the ascent of organisms, for a scheme of classification for formal species is needed only for the purpose of ready reference. Comstock has stated the question well in the following paragraphs:*

* 'Evolution and Taxonomy,' Wilder Quarter-Century Book, pp. 44 and 45.

There will also arise, I believe, in a work of this kind, a necessity for distinguishing between the essential characters of a group and those characters which are used by the systematist merely to enable students to recognize members of the group. For it seems to me that the essential characters of a group of organisms do not lie necessarily in the presence or absence of any structure or structures, or in the form or any part or parts of the body of the living members of the group; but rather in the characteristic structure of the progenitor of the group, and in the direction of specialization of the descendants of this progenitor. The recognition-characters are those usually first observed by the investigator, and are those commonly given in taxonomic works. In many cases these recognition-characters are also essential characters, especially in the case of groups that have been thoroughly studied. But by the taxonomic methods now commonly used, search is chiefly made for recognition-characters. The more skilled the systematist the more likely is he to discover and use as recognition-characters those that are really essential, although the distinction pointed out here may not be recognized by him.

Very likely we shall not abolish the present systems of nomenclature and description in the larger units, but we shall modify and extend them. We shall break away from the old lines of cleavage. We shall learn what marks that are correlated with function can be used as expedient diagnostic characters. We shall make an increasing effort to use absolute characters, not merely relative and comparative ones. We ought to make the 'type' of the species the real biological or phylogenetic type, not cling merely to the 'original' specimen that chanced first to be named. What we now call 'types' may be wholly unusual and even non-significant forms. If the book or literary type is in time to be the real type, then we shall re-group our species-units, and this will be the greatest possible gain.

If we decide that literary-species must come, in the future, to correspond to the physiological or elementary species, then we may hope to express the direction of evolution fairly well in our taxonomic schemes. These taxonomic schemes must proceed centrifugally and dichotomously rather than lineally. They must arrange about foci. I wish to quote again from Comstock:

If the history of a group be worked out in the manner indicated, the student will feel the need of recording his results in such a way as to indicate the phylogeny of the divisions of the group. But as the necessities of book-making require a linear arrangement of descriptions, this is somewhat difficult; for the natural sequence of groups should be represented by constantly branching lines rather than by a single straight line.

It seems to me that the most practicable way of meeting this difficulty is to begin with the description of the most generalized form known, and to follow this with descriptions of forms representing a single line of development, passing successively to more and more specialized forms included in this line. When the treatment of one line of development has been completed, take up another line, beginning with the most generalized member of that line and clearly indicating in the text that a new start has been made.

In making the foregoing suggestions I am well aware that I have not devised any definite nomenclatorial or taxonomic schemes by which they can be carried out. I doubt whether it is worth while to devise any schemes. We need only to establish a few principles and to look upon the present methods as temporary, allowing new methods to grow as our ideas grow. There can be no finality in such schemes or systems. We have lately seen a vigorous revival of the effort towards 'stability' of nomenclature; but nomenclature is only a bit of language, and language can never be stable if it is vital. It was the old idea that systematic work is for the purpose of making record; it is the new idea that it is for the purpose of expressing the meaning of the organic creation.

Ethology and the Mutation Theory: William Morton Wheeler, Curator of Invertebrate Zoology, American Museum of Natural History.

"The mutation theory," as we learn

from the opening sentences of de Vries's celebrated work, "asserts that the characters of organisms are built up out of units distinctly different from one another. These units may be combined to form groups, and in allied species the same units and groups keep recurring. Transitions, however, such as are so abundantly represented in the outer forms of plants and animals no more occur between these units than between the molecules of chemistry." It follows as a corollary from this statement that species must be conceived to arise from preexisting species by discontinuous variations, or mutations, and not by fluctuating variations, or variations proper. The theory is built on a number of remarkable facts derived from breeding organisms, with special attention to their morphological characters or attributes. I have been asked to consider the question as to whether the theory will apply also to the behavior or ethological, as well as to the morphological, aspect of organisms.

The biologist finds it well to distinguish carefully between structure and function, just as the psychologist finds it greatly to his advantage to distinguish sharply between the psychic, on the one hand, and the physiological and morphological, on the other. For the purposes of discussion I will take the standpoint of the biologist in so far as it relates to the distinction between structure and function, but I will combine under function both the physiological and psychological aspects as together constituting ethology, at any rate to the extent that they are involved in the behavior of organisms.

Now, inasmuch as ethology deals with processes, or phenomenal diversity in time, whereas morphology deals with the spatial diversity of phenomena, it is evident that ethological must be very different from morphological characters. It might even be said that the ethologist has no right to speak of a process as a character or characteristic, and the original Greek meaning of these words would seem to limit their use to the structural configurations resulting from specific acts or processes. This need not prevent us, however, from extending the meaning of the terms to include also the typical and specific reactions of the organisms to their environment. Certainly in the case of the human species, which is best known ethologically, the terms character and characteristic are hardly used of physical structures, but almost exclusively of typical modes of activity.

In its application to ethology the mutation theory can only mean that organic species must differ from one another by discrete idiosyncrasies of behavior. Most biologists would probably regard any discussion of mutation from the ethological standpoint either as superfluous or as necessarily and merely confirmatory of the results of morphological study. In their opinion it would follow as a matter of course that the functional and ethological characters of organisms must fluctuate or mutate according as the structural characters vary continuously or discontinuously. In my opinion this is not so self-evident as it would appear to be at first sight.

It is true, of course, that the various structural categories from the phylum down to the species, subspecies, variety, sex and individual—all show what may be regarded as correlated or corresponding ethological characters, although this correspondence is often very loose, vague and irregular, for it is evident that slight morphological may be correlated with complex ethological characters, and conversely. Some such correspondence may also be observed in hybrid forms. All this is usually taken for granted, and as a consequence the theory of an ethophysical parallelism, on the model of the famous psychophysical parallelism seems to have been tacitly accepted by many biologists. If we follow up the matter, however, we soon find that in the field of possible observation the ethological tend to outstrip the morphological characters. We observe great differences in habits and behavior between genera of the same family, between species of the same genus, and what is most significant, between individuals and even twins of the same species. At the same time we may be utterly unable to point out the corresponding structural differences, which, according to any theory of parallelism, should accompany such pronounced ethological distinctions. What bold man, for example, will undertake to show us the morphological characters corresponding to such striking differences in behavior as are manifested by the horse and the ass, by cats or dogs of the same litters, or children of the same parents? Of course, we are at once reminded that there must be corresponding morphological differences represented by cell-structures, biophores, ids, complex chemical compounds, etc. We are compelled to admit that these may exist, but until a function can be shown to be correlated with a particular structure, the structure is, of course, to all intents and purposes a purely hypothetical and imaginary entity. It is clear that the prestige of morphology has been artificially enhanced by a continual appeal to complex invisible structures. Whatever may be the truth concerning such structures, it is undoubtedly a matter of considerable theoretical and practical importance that we are able to detect ethological where we can not detect morphological differences or characters.

We may, in fact, be permitted to reverse the matter and take the point of view of the psychologist and metaphysician rather than that of the morphologist. In other words, we may start with behavior or the dynamic, *i. e.*, physiological and psychological processes of the organism, and regard the structure as their result or objectivation. The organism makes itself—the *ethos* is the organism. In this sense the honeycomb is as much a part of the bee as is her chitinous investment, and the nest is as much a part of the bird as her feathers, and every organism, as a living and acting being, fills a much greater sphere than that which is bounded by its integument.*

Although the time is so very limited, permit me to digress somewhat further on a more practical consequence of the view here advocated. We are certainly justified in regarding ethological characters as very important, as belonging to the organism and as being at least complementary to the morphological characters. If this is true, our existing taxonomy and phylogeny are deplorably defective and one-sided. To classify organisms or to seek to determine their phylogenetic affinities on purely structural grounds can only lead, as it has led in the past, to the trivialities of the species monger and synonym peddler. This has been instinctively felt by all biologists whose development has not been arrested in the puerile specimen-collecting stage.

* Compare, in this connection, the following passages from Schopenhauer's well-known essay on Comparative Anatomy (Ed. Frauenstedt, Bd. 4, pp. 45 and 58): "Man betrachte die zahllosen Gestalten der Thiere. Wie ist doch jedes durchweg nur das Abbild seines Wollens, der sichtbare Ausdruck der Willensbestrebungen, die seinen Charakter ausmachen. * * * Aus meiner Lehre folgt allerdings, dass jedes Wesen sein eigenes Werk ist. Die Natur, die nimmer lügen kann und naiv ist wie das Genie, sagt geradezu das Selbe aus, indem jedes Wesen an einem underen, genau seines Gleichen, nur den Lebensfunken anzündet und dann vor unseren Augen sich selbst macht, den Stoff dazu von Aussen, Form und Bewegung aus sich selbst nehmend; welches man Wachsthum und Entwickelung nennt. So steht auch empirisch jedes Wesen als sein eigenes Werk vor uns. Aber man versteht die Sprache der Natur nicht, weil sie zu einfach ist."

Embryology, by no means a purely morphological science, but one daily assuming a more physiological aspect, has come to have a weighty voice in matters of classification. More recently chorology, or biogeography—a distinctively ethological science—has come to play an equally important part. And rightly, because the organism may be said to seek, and in many cases even to make, its own environment. Every field naturalist knows that he is frequently guided to the more delicate specific and varietal distinctions, not so much by the structural differences between the organisms he is observing, as by differences in their habitat or behavior. Then closer scrutiny may often, although not always, reveal correlated structural differences. When such structural differences are not to be detected we speak of ethological species, and the number of these is undoubtedly much greater than was formerly supposed.* The great reliance on geographical distribution in the more refined taxonomy of certain groups of organisms, like the birds, mammals and social insects, shows an ever-deepening appreciation of ethological characters. It is even jocosely asserted that certain mammalogists are quite unable to identify a specimen unless they are first informed of the exact fence-corner in which it was trapped. Then, and not till then, are they able to perceive the delicate specific or subspecific shade of pelage which goes with life in that particular corner.

The fact that the morphologist has so consistently either neglected or opposed the use of ethological characters in classification shows very clearly that in his heart of hearts he has never very earnestly concerned himself with the parallelism of structure and function. He is inclined to regard function, especially psychical function, as something utterly intangible and capricious. For does it not seem to make its appearance in the embryo or young *after* structure has developed, and to depart at death before the dissolution of visible structure? And are not our museums largely mausoleums of animal and plant structures which we can forever describe and redescribe, tabulate and retabulate, arrange and rearrange, without troubling ourselves in the least about anything so volatile as function?

It is, indeed, not only conceivable, but very desirable, that a taxonomy should be developed in which the ethological will receive ample consideration, if they do not actually take precedence of the morphological characters. It is certainly quite as rational to classify organisms as much by what they do as by the number of their spines and joints, the color of their hairs and feathers, the course of their wing-nervures, etc. To regard our existing purely structural classifications as anything more than the most provisional of makeshifts, is to ignore the fact that the vast majority of organisms which they are designed to cover are known only from a few dead exuviæ. There are, of course, enormous difficulties in the way of constructing ethological classifications, quite apart from the fact that our knowledge of behavior is even more fragmentary than that of structure, as any one will realize who tries to write an ethological description of some common animal or group of animals. In morphology the elements of description can be treated as parts of an orderly and traditionally respected routine, but in ethology we still lack the necessary preliminary analysis of the more complex instincts, and are therefore unable to construct uniform and mutually comparable

* I have in mind a number of cases among insects, such as certain species of ants. There are American forms of the genera *Pheidole*, *Myrmica*, *Myrmecocystus*, *Formica*, etc., which exhibit geographical differences in habits without perceptible morphological differences.

descriptions. One great desideratum in ethology at the present time is a satisfactory and sufficiently elastic working classification of the instincts and reactions, like that of the organs and organ systems of the morphologist. Such a classification can be developed only by comprehensive, comparative study of behavior in a number of genera and families and not by any amount of intensive study of a few reactions in a few species.*

It seemed necessary to discuss ethological characters at some length for the purpose of vindicating their importance. Having attempted this, I may say that these characters seem to me to offer even fewer difficulties than the morphological characters to the acceptance of the mutation theory, for the reason that the ethological and psychological processes are conceived primarily as qualities and not as quantities. Thus the psychical elements, *i. e.*, the simple feelings, cravings and sensations, are disparate qualitative processes which can not be derived from one another or from some more undifferentiated process. This is still more evident in the case of the complex psychical phenomena. Similarly, instincts, with which ethology is most concerned, when resolved into their simplest components are seen to consist of discrete reactions which can not be shown to arise from one another. Although, on the other hand, the measurable intensities and durations of the reactions are analogous to the fluctuating structural variations, it is even more difficult for the psychologist to conceive of a particular feeling, craving or sensation as arising from the greater or less intensity or duration of some other psychic process, than it is for the morphologist to conceive of the origin of new characters from the fluctuating variations of structure.

* An avowedly provisional but elaborate 'System der thierischen Triebe' was suggested several years ago by G. H. Schneider in an interesting work ('Der thierische Wille,' Leipzig, Ambr. Abel, 1880), but subsequent workers have not even adopted, to say nothing of having perfected, the schema.

It is, of course, extremely difficult to determine the first inception of an instinct process, as one may point to the mutational inception of a structural character. An instinct is not an isolated manifestation, but is always more or less influenced by or inextricably bound up with other instincts. Nor do we know of any instinct which manifests itself only in a single species. Still there are numerous cases in which we seem to see more or less clearly the phylogenetic change from one instinct to another. Take, for example, the change from a flesh-eating or insectivorous to a granivorous or vegetarian instinct, a change which has undoubtedly taken place many times in the animal kingdom and is still taking place, especially among insects, birds and mammals. The organs which are useful in obtaining, comminuting and digesting animal food will function with a certain degree of efficiency when vegetable food is substituted, and the animal can pass either at once from animal to vegetable food or through a stage in which both kinds of food are eaten. In the latter case, only after the transition has been completed can we suppose that the organs will begin to assume the more perfect structural adaptations to a vegetarian diet. The state in which the animal is both carnivorous and vegetarian may be regarded as one in which two instincts coexist, and the purely vegetarian is reached by the mutational acquisition of a new and the mutational loss of an old instinct. Undoubtedly many changes of instinct are brought about in this manner so analogous to what has been called in morphology the 'substitution of organs.'

Mutation is even more urgently demanded for the explanation of many other instincts, especially those of symbiotic and parasitic species and of species with profound and sudden metamorphoses. In these cases a particular activity, on which must often depend the life of the individual or of its progeny, has to be performed with a high degree of proficiency at its very phylogenetic inception or it can be of no advantage to the individual or the race. Such cases, with which you are all sufficiently familiar, have ever been the insurmountable obstacle to the evolution of instincts on the theory of fluctuating variations and natural selection. The theory of organic selection seems to me merely to conceal but not to overcome the difficulties. The mutation theory frankly avoids the difficulties even if it fails to throw any light on the origin of the mutations, and bundles this into the germ-plasma. It is, of course, no objection to the theory that it leaves something under the heavens to be accounted for. This is rather to be regarded as one of its chief virtues. As working naturalists we have reason to be most suspicions of the theories that explain everything.

*Discontinuous Variation and the Origin of Species:** Dr. D. T. MacDougal, New York Botanical Garden.

That distinct and separate qualities expressed in recognizable external characters may appear suddenly, or disappear completely, in a series of generations of plants, has been a matter of common observation so long that it would be difficult to hunt out and fix upon the first instance of record.

The significance of such phenomena was obviously beyond the comprehension of the earlier botanists, and it is evident that a rational recognition of the phylogenetic value of sports and anomalies necessarily awaited the development and realization of the conceptions of unit-characters, of the minute structures which are the ultimate bearers of heredity, and of the interdependence of the two in such manner as to constitute actual entities as embodied in Darwin's pangenesis, de Vries' intra-cellular pangenesis and in Mendel's investigations upon heredity. It is equally apparent that a proper interpretation of the facts in question, and their distinction from the results of hybridization were possible only by means of the analysis of the collated results of observations upon series of securely guarded pedigree-cultures, in which the derivation of all of the individuals of several successive generations had been noted. For it is now thoroughly realized that the main questions of descent and heredity and of evolution in general are essentially physiological, and as such their solution is to be sought in experiences with living organisms and not by deductions from illusory 'prima facie' evidence, which has been so much in vogue in evolutionary polemics, nor by 'interpretations of the face of nature' with the accompanying inexact methods and superficial considerations. It was upon the safe basis of the first-named conceptions, and by means of the methods entailed, that de Vries so successfully grappled with the problems involved in the investigation of the part played by discontinuous variation in evolution.

In view of the amount of orderly and well-authenticated evidence now at hand, it may be regarded as demonstrated that characters, and groups of characters, of appreciable physiological value, originate, appear in new combinations or become latent, in hereditary series of organisms, in such manner as to constitute distinct breaks in descent.

This is the main thesis of the mutation theory—the saltatory movements of characters, regardless of the taxonomic value of the resultant forms. That the derivatives

* See also, MacDougal, D. T., 'Discontinuous Variation and the Origin of Species.' *Torreya*. 5: Jan., 1905. Pp. 1–6.

might be considered as species by one systematist, and varieties by another, is quite incidental and of very little importance. The main contention lies in the claim that characters of a definite nature appear, and become inactive suddenly, and do not always need thousands of years for their infinitely slow external realization, or for their gradual disappearance from a strain.

Of course the principal corollary of the mutation-theory is that the saltations in question do result in the production of new species and varieties. As a matter of interest it may be stated that the systematists who have seriously examined the adult mutants of the evening-primroses cultivated in the New York Botanical Garden have unanimously held the opinion that certain ones were to be considered as species and others as varieties.

Furthermore, these conclusions are confirmed when the characters of the mutants are subjected to statistical methods of investigation. In the observations of Dr. Shull, which will be presented more fully before the Botanical Society of America, it has been found that qualities of the mutants, susceptible of measurement, depart definitely and clearly from the parent-type and fluctuate about a new mean, and do not intergrade with the parental form. The amplitude of fluctuation about the new center is greater than that of correspondent parental qualities, and the degree of correlation is much less in the mutants than in the parent. This is seen by inspection to be true in one species during the first year of its existence, and is confirmed by the exact observations on other forms a dozen years after their mutative origin. Consequently the features in question may not be taken to be in any way the result of selection, but are in themselves new qualities.

Lamarck's evening-primrose offers such striking and easily recognizable examples of discontinuous variation, and has been the object of so much detailed study, that we are in danger of giving way to the supposition that the mutation-theory rests upon the facts obtained from this plant alone. It is to be said, however, that if the evidence obtained from it and all of its derivatives were obliterated, the results of experimental studies which have been made upon mutations in other species, upon the behavior of retrograde and ever-sporting varieties, the occurrence of systematic atavism, and of taxonomic anomalies, pelorics and other morphological features, would furnish ample support for the conception of unit-characters, and serve to establish the fact that mutations have occurred in a number of species representing diverse groups.

It is now becoming plainly apparent that the phenomena of hybridization, by the opportunities afforded for the study of the included unit-characters in a segregated condition; for the analysis of complex characters, and of the various principles governing the transmission, activity, dominancy, latency and recessivity of characters promises to yield results of the first magnitude concerning the mechanism of descent and heredity. The possibilities, among plants, of crosses between species, comparatively widely different in morphological and physiological constitution, indicate that the ultimate generalizations upon hybridism will find a broader exemplification in plants than in animals.

It is pertinent to point out in this connection that the unguarded use of the terms 'variation' and 'mutation' to designate phenomena of segregation and alternative inheritance, when races or species are thrown together in a hybrid strain, is bound to result in much confusion, especially in dealing with plants, since it is well known that direct mutants of either parent occasionally occur in such mixed strains.

From this last consideration we pass naturally to a discussion of the nature of the material which may be of use in the study of fluctuating and discontinuous variability. It needs no argument to support the assertion that a successful experimental analysis of the behavior of separate characters may be carried out only when dealing with series of organisms fluctuating about a known mean with a measurable amplitude of variability.

Systematic species as ordinarily accepted generally consist of more than one independent and constant subspecies, or elementary species which may not be assumed to interbreed or intergrade, unless actually demonstrated to do so by pedigreed cultures. So far but few elementary species have been found to interbreed. A due recognition of this simple fact would save us a vast amount of pyramidal logic resting on an inverted apex of supposition.

Again, the accumulation of observations upon the prevalence and effect of self- and cross-fertilization has totally unsettled the generalizations current within the last few decades. Briefly stated, a moderate proportion of the flora of any region is autogamous, a large proportion both autogamous and heterogamous, and a moderate proportion entirely heterogamous. The relative number of species included in the categories indicated varies greatly in different regions. To assert the deleterious effects of self-fertilization of all, or a majority of plants, is to base a statement upon evidence that lacks authentication, as has been strikingly demonstrated by recent results. As a matter of fact no phase of evolutionary science is as badly in need of investigation as that which concerns the effects of close- and cross-breeding.

It is also to be said that current misconceptions as to the extreme range of fluctuating variability of many native species have arisen from a failure to recognize the composite nature of the Linnean, or group-species upon which observations have been based, as I have found with the common evening-primrose.

The demands of ordinary floristic work are usually met by the formulation of collective species, which are an undeniable convenience, and perhaps a necessity for the elementary teacher and the amateur. Upon the specialist in any subject rests the obligation to furnish his non-technically trained constituency with conceptions of the facts and principles within the domain of his investigations, which will be inclusive, and easy of comprehension. But if, in accordance with this requirement, the systematist contents himself with this looser, and with due regard it may be said, more superficial treatment, and does not delineate clearly the elementary constituents of a flora, or falters in carrying his analysis of relationships to its logical end, he fails notably in the more serious purpose of his investigations, and his work must be supplemented and extended before it becomes an actual basic contribution to the physiologic, or phylogenetic, branches of the science. To study the behavior of characters we must have them in their simplest combinations. To investigate the origin and activity of species we must have them singly and uncomplicated.

Lastly, we may turn to a phase of the subject which has, as yet, received nothing but speculative consideration—that of the causes which induce the organization of new characters and which stimulate their external appearance. The recurrence of the known mutants of Lamarck's evening-primrose and the occurrence of new mutants of other species have taken place in New York and Amsterdam under conditions that lead to the definite conclusion that a favorable environment, including the most advantageous conditions for vegetative development and seed-production, facilitates the activation and appearance of latent qualities, and the inference lies near at hand that such conditions also participate as causes in the original organization of new unit-characters, or in changes in these entities. We conclude, therefore, that favorable environment promotes the formation of new species as suggested by Korshinsky, and that new species do not arise under the stress of infra-optimal intensities of external factors as proposed by Darwin.

Furthermore, it has been found that certain qualities arise and disappear more numerously, and presumably more readily, than others, in a mutating strain. Thus those embodied in the mutants *oblonga*, *lata* and *nanella* find external realization in many more individuals than those which constitute the differentiating features of *rubrinervis, scintillans, gigas, elliptica, subovata* and others.

Again, the inspection of the cultures made in Amsterdam and New York demonstrates that the last-named locality offers more favorable soil and climate for the evening-primroses. Correlated with this I am able to report that careful attention to the cultures has resulted in an increase of the proportion of mutants from the five per cent. maximum of de Vries to more than six per cent. in the last season, in the American cultures, and to say that some forms which did not reach maturity, and others which did not occur in Amsterdam, may find in New York a climate in which they may carry out their entire development. The cultures of Lamarck's evening-primrose now being carried on include fourteen recognizable mutants, and it is pertinent to state that I have mutants of other species which will be duly described after they have completed a cycle of development.

All components of the environment may not be taken to be of equal value in the induction of new qualities, and I by no means wish to give the impression that the problem is on the point of being solved, but our hopes have been raised to the highest pitch that we may soon be able to discern the factors more or less directly concerned.

To be able to bring the causes that are operative in the formation and structural expression of qualities, *i. e.*, the moving forces of evolution, within the range of experimental investigation would be a triumph worthy the best effort of the naturalist; in that it would give us the power to give new positions to qualities and thus to produce new organisms, its importance would rank well with that of any biological achievement of the last half century.

SCIENTIFIC BOOKS.

The Zoological Record, Vol. XL., being records of zoological literature relating chiefly to the year 1903. Edited (for the Zoological Society of London) by David Sharp. London. 1904. [Published early in 1905.]

The Zoological Record, which has now been published for forty years, is simply invaluable to the working zoologist. This statement seems so trite as to be ridiculous, but the fact is not known to some of those who most need the work. Some time ago I received letters from a well-known naturalist, asking for information concerning a group, the North American species of which he was cataloguing. In my replies I referred to the *Zoological Record;* but the answer came back: 'Do not refer me to the *Zoological Record*, it is not accessible to me.' I do not cite this as an unusual case; on the contrary, one continually observes that writers have not seen the *Record*, and have missed various things in consequence.

Consider for a moment what a time-saver the *Record* is, and how many oversights it prevents. Suppose I want to know about some genus of animals, literally *any* genus that may be mentioned; in half an hour I can find out what new species have been described in that genus, or important things said about it, in the last ten years. Without the *Record* I might spend days in the quest, and then not find what I wanted.

I have tried the Zurich cards (Concilium Bibliographicum), but have not found them so satisfactory. In a discussion at a meeting of the American Association for the Advancement of Science a few years ago, Professor H. B. Ward stated that for his purposes the cards were preferable to the *Record*, so one must grant that needs differ; yet I can not imagine that a taxonomic worker could do without the *Record*. The cards, as printed, do not list the species separately, although it is now possible to obtain manuscript species-cards for a small sum. Even if cards were printed for all the species, as is done for plants at the Gray Herbarium, I do not think they would be so serviceable as the pages of the *Record*, wherein the eye can pass rapidly over the names of dozens of species, without having to turn over cards. On the other hand, when one has to do with a long series of years, the advantage of an alphabetical arrangement of *all* the species of each genus, and of *all* the genera of each family, is very great; and here, in the long run, the cards will have the advantage. When this time comes, however, it is hoped that the whole will be transferred to printed pages, like the 'Index Kewensis' and Sherborn's 'Index Animalium.' With regard to the International Catalogue, I need say nothing after Professor Ward's recent review (Science, January 27, p. 147); but I was very glad to learn, when in England last summer, that the Zoological Society will not abandon the *Record* while the International Catalogue is conducted on the present basis.

The great superiority of the *Record* is, of course, due to the fact that it is prepared by men who have the most intimate acquaintance with the subjects recorded. In no other way can the work be done satisfactorily, and zoologists ought to feel sincerely grateful that men like D. Sharp, G. A. Boulenger, F. A. Bather, E. A. Smith, R. B. Sharpe and others are willing to labor in their service; to labor, it may be added, for the most trifling pay. Under Dr. Sharp's editorship, the work has greatly improved, and has reached a really marvellous standard of excellence, tested by the groups of which one has particular knowledge. I do not mean to say that there are no errors; but they are remarkably few, and none are due to gross ignorance, like some of those in the International Catalogue. One amusing slip, a few years ago, is worth citing, but it is wholly exceptional. An entomological article was published 'By J. D. Tinsley, A. & M. College, Mesilla Park, N. M.' The Zurich card came in due course, with the article credited to 'J. D. Tinsley ana M. College.' I said to myself, that is a blunder the *Zoological Record* would never make; but behold! when it arrived, it contained exactly the same blunder. I dare say M. College will be long remembered as an entomological writer.

Every new volume of the *Record* reminds one of the perennial subject of zoological nomenclature. It does seem that the publication of homonymous generic names is somewhat abating, but I notice in the present volume *Acanthophallus*, Luehe (not Cope, 1893), *Aldrichia*, Theobald (not Coquillett, 1894), *Aporema*, Dall (not Scudder, 1890), *Angelia*, Lower (not Berlese, 1885), *Kirbya*, Melichar (not Desvoidy, 1830), *Nicholsonia*, Tutt (not Kiaer, 1899), *Pleroma*, Melichar (not Sollas, 1888), *Rhynchomys*, Fairmaire (not Thomas, 1895), *Rileya*, Huene (not Howard, 1888), *Thaumasia*, Westerlund (not Perty, 1830), and some others. All these will of course have to be changed. There are also many names which are nearly the same as others, most of which will probably be changed by some one. I am strongly of the opinion, myself, that they should be let alone; as they are distinguishable, and the necessary changes of names are numerous enough. At the same time, it would save trouble if authors would not propose such names. Examples out of the present record are: *Abbottina*, Jordan & Fowler (not *Abbottana*, Hulst), *Asthenoceros*, Laidlaw (not *Asthenoceras*, Buckman), *Biroa*, Bolivar (not *Biroia*, Szep.), *Boccharis*, Distant (not *Bocchoris*, Moore), *Bolla*, Mabille (not *Bollia*, Jones), *Charidia*, Mabille (not *Charidea*, Baly), *Epimela*, Weise (not *Epimelus*, Edw.), *Greya,* Busck (not *Graya,* Guenth.), *Guerinius,* Ashmead (not *Guerinia,* Bate), *Imeria,* Cameron (not *Imera,* Pascoe), *Ivela,* Swinhoe (not *Ivella,* Lubbock), *Nisia,* Melichar (not *Nisa,* Casey), *Occia,* Tosquinet (not *Occa,* Jord. & Everm.), *Reuterella,* Enderlein (not *Reuteriella,* Signoret).

A few generic and subgeneric names have been omitted; I notice the following: *Crewella* (*An. Mag. N. Hist.,* XII., 202), *Martinella* (*An. Mag. N. Hist.,* XII., 450), *Gueriniella* (Fernald, 'Cat. Coccidæ,' 331), *Kuwania* (*t. c.,* 32), *Kuwanina* (*t. c.,* 121).

It is worth while to say something about the importation of the *Record.* It used to come promptly by mail, but the 1902 volume was just overweight. It was mailed, nevertheless, by the Zoological Society, with the understanding that it would be delivered as before. The British postal authorities took it out of the mails, and turned it over to the American Express Company, with whom they have a contract for the carriage of parcels too heavy for the transatlantic mails. The volume arrived in New York, but was not forwarded until considerable delay had occurred and I had been obliged to pay extra express charges and a heavy import tax. This year, by using lighter paper, I believe, the book was kept just within the specified weight, and it came promptly by mail, with no trouble and no customs dues. It is an outrage to charge duty on a book of this sort, published at a loss, and one would like to know why the charge was made in one case when it was not found necessary in the other.

It is proper to add, that whereas the *Zoological Record* was formerly to be had only as a complete volume, the several subjects may now be purchased separately at moderate prices.

T. D. A. Cockerell.

Les Lois Naturelles: Réflexions d'un Biologiste sur les Sciences. By F. Le Dantec. Paris, F. Alcan. 1904. Pp. xvi + 308.

M. Le Dantec has two motives in view: to determine the meaning of the words 'natural law,' and, on the basis of this determination, to define or to revise the main scientific conceptions in use to-day. The meaning of 'natural law' is investigated from a standpoint due to the teachings of biology, with a resulting definition which resembles those of Pearson, Mach, Ostwald, Poincaré and others, and is in substantial accord with the general 'humanistic' philosophy. The author then discusses the meaning of such conceptions as straight line, plane, continuum, mass, force, entropy, absolute zero, inertia, conservation of energy, atom, ether, living matter, thought. With so broad a field to cover, the treatment of each conception must needs be brief; but it is at least direct, systematic and clear.

In the introduction (16 pp.) the general considerations are laid down which will determine the author's definition of natural law. Of the external world we know only the ways in which it affects us, the relations it bears to us. These ways or relations come to us through several gateways—namely, the senses—which the author calls the 'sensorial cantons' (sight, touch, temperature, smell, taste, etc.). Of these there are, we are told, many more than physiology admits, though we are not given a complete list of them. They are each irreducible, inexpressible in terms of any other sense. What we see has form and color, but is not loud nor hot; temperature has no color nor sweetness, tastes are not square nor round. What is revealed to one sense can not properly be described in terms of any other sense. Now science is first of all a record of these quite different classes of sense-impressions.

The subject is continued in Book I., 'The Sensorial Cantons and Monism.' Man is not only passive toward the external world. He reacts upon his environment; and in order to do so he makes hypotheses about the constitution of that environment. In the early stages of man's development these are quite as likely to be useless as not, but natural selection preserves the useful and weeds out the useless, till in the course of ages the former become instinctive. Thus our instinctive belief that arithmetic is infallibly correct, or that unsupported bodies fall, is the 'hereditary résumé of ancestral experience' (p. 3). We regard it as an *a priori* truth because the belief has been so long perpetuated by natural selection.

This is the meaning of natural law, and the extent of its validity and the validity of all our reasoning must be judged in the light of this meaning. Our elementary laws of motion can not be assumed to hold of bodies too small for observation, or too remote in space. Science is not absolute in any sense (p. 8). But not only do we react on our environment in accord with many acquired beliefs; we seek economy in our reactions and our beliefs. We find it easier to indicate what will happen in the various sensorial cantons by using the terms of one sense, namely, sight. Because sight gives greater precision and covers a wider field of phenomena than any other sense, we find it most convenient to frame our hypotheses in regard to the constitution of the other cantons in terms of what sight reveals—namely, the motion of bodies. Thus we describe sound, heat, light as wave-motion. It is the hope of covering all the phenomena of the other cantons by the terminology of sight that leads to monism. Yet what is vouchsafed by the various senses remains really disparate, *sui generis* in each canton.

In Book II. we consider the sciences of the 'optical canton'—more familiarly known as the exact sciences. The language of mathematics is the language of vision. It is based directly on sense-impressions. There is no 'free creation by the mind' of the fundamental mathematical conceptions. The straight line is given in the thread suspending a weight, the plane in the surface of a liquid, the continuum in any body in which we see no gaps. These sense-impressions may turn out later to be illusions, but are none the less really given. Arithmetic, algebra and geometry detail the properties of such data omitting the element of time; kinematics and mechanics include the latter. The infinite and infinitesimal are not picturable, therefore they are figures of speech. Nor could we tell what laws they would obey, since logic is based on what we have experienced, and can not be assumed to hold of regions beyond our senses. Just so, atoms may not obey the laws which larger bodies obey, and the ether may not be impenetrable.

How do we come to use other conceptions here besides those of space and motion? Because these are found insufficient for the prediction of the behavior of bodies. Thus we find it convenient to speak of mass, which the author defines as 'that coefficient found in one and the same body, in all the systems of which it forms a part' (p. 87). Velocity is that which corresponds to the intensity of our sensation of motion (p. 94). Force is not a cause of motion; for such a conception imports the muscular sense into the visual field, which is not allowed. Quantity does not apply beyond the visual field. Incidentally, Fechner's law is declared impossible, since it attributes quantity to other cantons besides the visual. What we really measure is not force as an existing quantity of something, but only $m \times a$, a numerical product. That force is a fiction is shown also when we remember that in statics any one force may be replaced by an infinity of others equivalent to it. Since all these can not be really present, there is no reason for saying any one is more real than the rest. The law of action and reaction is the experimental fact that in an isolated system the algebraic sum of the partial energies is *nil*. The conservation of mass has become so well known as to be almost an *a priori* law.

In Book III., 'The Other Cantons,' the discussion is confined to sound and heat, principally to heat. Temperature can be studied scientifically because it alters the shape of bodies. The conservation of heat is simply a definition of a complete system: a complete system is one in which the algebraic sum of the quantities of heat gained by the parts is *nil* (p. 148). 'Source of heat' and 'absolute zero,' like force, are fictions. Equivalence of heat and mechanical energy does not mean preservation of a permanent something; it is only a useful device for correlating heat with visual phenomena. The conservation of energy is only such a correlation made general; it is an empirical truth at most, and even if radium creates energy *de novo* it need not disturb us (pp. 207–9).

Book IV., 'Explanations,' resumes the general position of the author in regard to the meaning of scientific law. Atomic models do not explain; they simply enable us to take points of view fertile for discovery of new properties. Thus atomism is to be preferred to energetics, the latter, though nearer to fact and less liable to dangerous hypotheses, does not stimulate the mind to discovery. Better danger than the precision of sterility! (p. 229).

Biology (Book V., 'The Place of Biology among the Sciences') the author would regard as underlying zoology, botany, physiology, etc., even as theoretical mechanics underlies physics. As theoretical mechanics defines the motion of bodies, biology defines life, leaving to the detailed sciences the description of different forms of life. Life itself is defined as a localized process, like the flame, not a specific substance or energy, but a locus of points where certain reactions are accomplished. The characteristic property of life is assimilation (p. 288). Thought and other psychoses are described as a special sensorial canton 'le canton intime.'

The general position of the author, that sense-impressions are all we know, and that the sources of heat, light, sound, etc., are not *in themselves* describable in visual terms, is an extreme one and is open to all the objections which are being urged, rightly or wrongly, against 'humanism.' But further, it is quite dogmatic to say that quantity does not apply beyond the visual field, or that mathematics is the language of vision; what is needed is a more exhaustive account of the conceptions involved. It is also to be regretted that M. Le Dantec, as a biologist, has not made use of the discoveries of Mendel, De Vries and others, which inevitably suggest that the fundamental law of science is not mere determinism, as he says (p. 213), but chance (in the mathematical sense) as well. Nevertheless, the attempt of M. Le Dantec to give clear and concise definition of the principal scientific conceptions should be welcomed by scientists and philosophers alike, and should lead to further work in the same direction.

W. H. Sheldon.
Columbia University.

SOCIETIES AND ACADEMIES.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The section held its fifth regular meeting of the season at the Chemists' Club, Friday evening, February 10.

The president of the American Chemical Society, Dr. Francis P. Venable, presented to Professor Charles Lathrop Parsons, of the New Hampshire College, Durham, N. H., the Nichols medal, which was awarded to him for his paper entitled 'A Revision of the Atomic Weight of Beryllium,' read before the section in May, 1904. Mr. W. H. Nichols, the donor of the medal, was also present and made a few appropriate remarks.

The regular program of the evening was then taken up and the following papers presented:

The Accumulation and Utilization of Atmospheric Nitrogen in the Soil: E. B. Voorhees and J. G. Lipman.

The experiments planned included, first, a study of the question of the sources of nitrogen to leguminous plants on soils to which no nitrogen had been applied, and to which nitrogen in various forms and amounts had been applied; second, the availability of cow pea nitrogen, as compared with the different forms of nitrogen for the growth of nonlegumes; and third, the possibility of the accumulation of nitrogen in cultivated but uncropped soils.

The soils used were light in character, poor in nitrogen and supplied with an abundance of the mineral elements.

Briefly, the results show that the cow pea crop accumulated large quantities of nitrogen, and that the greatest accumulation was where no nitrogenous materials had been applied. Or, in other words, that the addition of the nitrogen decreased rather than increased the content of soil nitrogen, indicating that the leguminous crop will accumulate proportionately larger quantities of nitrogen upon soils relatively free from this element.

Millet was then grown two seasons, both upon the soils upon which the cow pea had grown, and upon which no crops had been grown, and without further application of nitrogen.

The final analyses of the crops and soils showed that the organic nitrogen contained in the cow peas, and accumulated largely from the air, was utilized by the succeeding non-leguminous crop, and that there was a gain of nitrogen in the soils where no cow peas were grown, and that such gains were greatest where the largest amount of manure had been applied.

The Detection of Methyl Alcohol: Heyward Scudder.

The formation of methyl salicylate is not a reliable test, because ethyl salicylate has almost the same odor. The Riche and Bardy test takes too long to be of practical value. The Trillat test (delicacy 0.2 per cent.) is uncertain. The deepening of the blue on heating is characteristic. Wolf and Robine state that Trillat's test is not reliable and give modifications that may be of value in cases of doubt. The Haigh (delicacy 5 per cent.) and Spanglé-Ferrière (delicacy 1 per cent.) tests use phloroglucine to show the presence of formaldehyde. The color obtained varies with the concentration of the formaldehyde. A blank test with ethyl alcohol must always be made. The effect of heat is characteristic. By using proper conditions a rapid test (delicacy 2 per cent.) can be made. The Mulliken, Scudder test (delicacy 3 per cent.) is very reliable because of the formation of flocks as well as color. On account of the uncertainty of color tests for small amounts, it is advised first to try a rapid test and, if no definite result is obtained to concentrate by fractionation.

The Origin of Radium: Bertram B. Boltwood.

It had been shown in previous papers that the determination of the relative quantities of uranium and radium in a number of minerals strongly indicates a constant ratio between the quantities of these elements occurring together. In the present paper improved methods for the quantitative determination of both radium and uranium are described, and the results obtained from an examination of twenty-two separate samples, comprising twelve distinct mineral species, are given. These results show a constant proportionality between the quantities of radium and uranium in all of the samples examined, and lead to the inevitable conclusion that uranium is the parent of radium.

F. H. Pough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE NATURALIST'S UNIVERSAL DIRECTORY.

A new edition of the 'Naturalist's Directory' has recently come to hand. In casually turning the leaves I noticed that the names of Joseph Le Conte and J. W. Powell were still retained in the list of American naturalists, although their deaths had occurred as long ago as 1901 and 1902. These lapses suggested that the directory might not be trustworthy in other respects, and at my suggestion an associate compared its lists with various other lists of scientific men, for the purpose of testing its accuracy and fullness. The practical utility of Cassino's directory in the past seems to be attested by the fact that it has reached its nineteenth edition, and I therefore feel justified in presenting, as a matter of general information, some of the results of the examination.

In order to judge of its fullness a comparison was made with the contemporary lists of a few scientific organizations whose membership is carefully selected on the basis of scientific ability or accomplishment. Of 90 members of the National Academy of Sciences the directory fails to include 28. It omits 129 of the 329 members of the Washington Academy of Sciences, 57 of the 233 members of the American Society of Naturalists, 11 of the 46 fellows of the American Ornithologists Union, and 54 of the 259 fellows of the Geological Society of America. Probably some members of each organization are not within the scope of the directory, but this remark can not apply to such men as Outram Bangs, C. F. Batchelder, Lyman Belding, Franz Boas, Lewis Boss, A. P. Chadbourne, C. F. Chandler, S. C. Chandler, W. W. Cooke, G. A. Dorsey, Wm. Dutcher, H. G. Dyar, H. W. Fairbanks, W. G. Farlow, J. W. Fewkes, Henry Gannett, A. C. Gill, L.

P. Gratacap, C. S. Hastings, J. P. Iddings, C. L. Jackson, S. P. Johnson, S. C. Keith, N. T. Lawrence, G. Lefevre, C. K. Leith, E. W. McBride, L. B. Mendel, T. C. Mendenhall, A. A. Michelson, John Muir, E. W. Nelson, E. L. Nichols, A. E. Ortmann, Wm. Palmer, H. S. Pritchett, T. M. Prudden, H. A. Purdie, E. F. Smith, J. C. Smock, R. Thaxter, O. H. Tittmann, John Trowbridge, W. L. Underwood, Lester F. Ward, A. G. Webster, E. L. Wells, C. A. White, S. W. Williston, H. C. Wood and R. R. Wright. It was not practicable to apply a similar test to the foreign lists, and it may be that they are fuller.

To test the accuracy of the addresses given they were compared with lists, of approximately the same date, published by the Washington Academy of Sciences, the Geological Society of America, the American Society of Naturalists and the American Ornithologists Union, and with 400 other addresses taken at random from 'Who's Who in America' and the lists of the American Association and the affiliated societies of Washington. In all about 750 addresses were compared, and it was found that about ten per cent. of those given by the directory are erroneous. Similar comparison was made of 291 names common to the directory and the list of the Geological Society of London, with the result that 52 addresses were found to be discrepant, but in this case it was not possible to say how many were wrong.

Of deceased scientists so notable that their deaths are recorded in the necrologies of the National Academy, the *American Journal of Science*, or the American 'Who's Who,' no less than 49 are retained by the directory. Among these are not only Powell and Le Conte, already noted, but Elliott Coues, Horatio Hale, James Hall, J. Willard Gibbs, St. George Mivart, Henry Morton, A. E. Nordenskiold, H. A. Rowland and Rudolph Virchow.

The arrangement of the names is by countries, with a classification which has been gradually evolved through successive editions. Part I. comprises, first, the United States and Canada, and then, in order, Great Britain, Central America, South America, Oceanica and Africa. Central America is made to include not only the usual states, but Mexico, Newfoundland and the islands of the West Indies; and the countries of Asia are placed under Oceanica. Part II. includes all the countries of Europe except Great Britain. The use of Part II. is facilitated by having its parts arranged in alphabetic order, and by the insertion of the name of the country at the head of each page; but these devices are not used in Part I. In some of the earlier editions the entries for the United States and Canada were numbered *seriatim* and a special index of departments of science referred to these numbers. From the present edition the index is omitted, but the numbers survive as a vestigial character.

The personal list for the United States and Canada is followed by a list of scientific societies of the same countries, with a classification by states. Being a resident of Washington, I turned, naturally, to the list for the District of Columbia, and noted at once the omission of the Washington Academy of Sciences and of nine out of the twelve scientific societies affiliated with it. Of the three affiliated societies that are listed the data for two are obsolete. The American Association for the Advancement of Science, which for seven years has had its headquarters in Washington, is still credited to Salem, the place of publication of the directory.

Despite these limitations the directory is a useful volume. It contains the names of about 18,500 scientists, with information as to addresses and specialties, and the greater part of the information is correct.

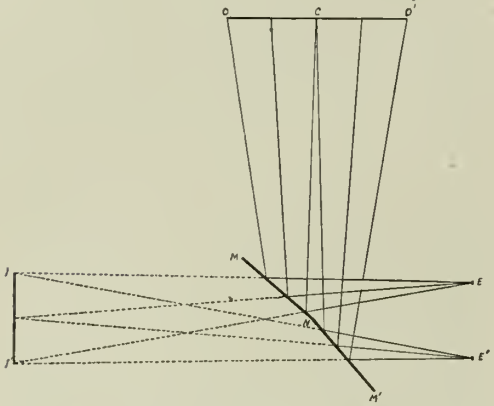
G. K. Gilbert.

AN OVERLOOKED FORM OF STEREOSCOPE.

In Science of November 18, 1904, Professor Jastrow describes, under the above heading, an ingenious modification of the mirror stereoscope, permitting the use of the ordinary stereoscopic card.

The arrangement described below, serving the same purpose, appears to possess some advantages. It is quite possible that this form may have been suggested before, but it has not come under my notice.

In all arrangements of this kind it is of advantage to bring the mirrors as near to the eyes as possible, as was done in Sir Charles Wheatstone's original arrangement. If we think of the mirrors, as we may from an optical standpoint, as simple openings through



OCO' is the stereoscopic card. *MN* and *NM'* are the two mirrors. *II'* are the superimposed images of *OC* and *CO'*, and *E*, *E'*, are the positions of the two eyes.

which we see the image, it is evident that the eye gains much in freedom of position and largeness of field, if it is brought near to the mirror, precisely as we go close to a window if we desire a more extended view. Also, since the edge dividing the mirrors is thus brought between the eyes, rather than in front of them, it is no longer seen, or at least is no longer troublesome, as it is to some extent when the mirrors are farther from the eyes. Indeed, the mirrors need not meet at all nor need they be of any regular shape.

With this arrangement two views may be combined which are considerably wider than those used in the ordinary stereoscope. I have found no difficulty with drawings six inches wide. The height of an object which can be successfully used is limited by the condition discussed below. But with views of the ordinary dimensions this stereoscope is entirely satisfactory in its performance, possesses a considerable range of adjustment, and is convenient for laboratory experiment, as it is easily and quickly put together with two bits of mirror and a little wax.

All forms of reflecting stereoscope using a single stereoscopic card have this imperfection in common, that the images formed by the two mirrors do not coincide, but intersect at a considerable angle. The images of any object formed by two mirrors lie, as is well known, on the circumference of a circle, the center of which is at the junction of the mirrors, and the images are separated by an angle equal to twice the angle between the mirrors. Since the relations between object and image are reciprocal, it is plain that if the images of two objects are to be superposed by means of mirrors, forming one image, the objects must lie on the circumference of the circle, and at the angular distance occupied by the images in the previous case.

If this condition is not fulfilled, but the objects are in the same plane, as when they are on the same card, the images, while nearly superposed, will intersect at an angle equal to twice the angle between the mirrors. In my stereoscope, as commonly used, the angle between the mirrors is about two and one half degrees, so that the images form an angle with each other of five degrees. The images are over three inches wide. If their planes intersect at the median line, the edges to the right and left are separated in the direction of the line of sight by more than an eighth of an inch. This is hardly noticeable across the breadth of the view, where the line of sight is nearly perpendicular to the intersecting edge of the mirrors, but becomes so near the top and bottom, where the slight deficiency in sharpness of the horizontal lines is easily traceable to their inclination. If the center of the card is pushed back so that the card forms an arc, approximately that of the circle on which the views should lie, the improvement in definition is strikingly evident.

It is an interesting illustration of the ease with which the eye is satisfied in such matters, that the stereoscopic result is excellent over the whole view, hardly failing at all even at the extreme edges, though formed by two images so disadvantageously placed.

Frank P. Whitman.
Western Reserve University,
Cleveland, Ohio.

KILAUEA AGAIN ACTIVE.

It may be of interest to the readers of Science to know that the fire has again returned to the world-renowned volcano Kilauea in the Hawaiian Islands after an absence of thirteen years. The citizens of Hawaii, who are intensely interested in this volcano, had well nigh despaired of witnessing another season of activity. The fresh lava appeared the last week of February, heralded by a slight earthquake. On the twenty-fifth instant it was not observed—smoke filling the pit. Two days later it is reported that a lava lake was on exhibition, two hundred and fifty feet long and one hundred feet wide. On March 10 the Volcano House reported that the lake is not so large as at first stated; but the crater is absolutely free from smoke. "Heavy rumblings and explosions indicate that another outbreak is imminent." Thus there seems to be a restoration of the old-time activity—such as will cause a large increase in the number of visitors.

Observations with a good spectroscope are needed. Professor Libbey used one there to good purpose a few years since, but did not name all the substances indicated. We especially need more information about the hydrogen flames, as well as the hydrocarbons. The latter substance is so commonly of organic origin that the best of evidence is required to fully establish a belief in its presence in this incandescent magma fresh from the realms of Pluto. It is hoped that some one who is skilled in the use of the spectroscope will utilize this opportunity to determine the nature of the substances now being emitted from this famous volcano. C. H. Hitchcock.

Hanover, N. H.,
March 23, 1905.

SPECIAL ARTICLES.

THE PRAIRIE MOUNDS OF LOUISIANA.

While it may not generally be appropriate to discuss the content of a paper on the basis of a mere abstract report by the secretary of a society, I venture to make some comments on the paper read by A. C. Veatch on the 'Natural Mounds of Louisiana,' at the late meeting of the Geological Society of Washington, as given in the last issue of Science; since I have made a number of such excavations as are called for by him.

I have briefly discussed these mounds in my final report on the geological reconnoissance of Louisiana made by me 1869, published in 1873. I dug into a number of them on the Opelousas prairie, and also on the Calcasieu prairie. Having just previously investigated the mudlumps of the Mississippi Passes, my first conjecture was that of mudspring origin; but the total absence of the characteristic 'onion' structure of such mudspring cones at once made me abandon this hypothesis. The total absence of any regular structure or stratification, such as characterizes all dune or other wind-drift structures, equally excluded these; as well as water erosion, since the soil and subsoil of the surrounding prairie are quite distinctly in horizontal layers. I, therefore, as shown in the paper alluded to, considered their ant-hill origin as the only reasonable explanation; raising the question as to how the once teeming population of these vast areas came to be destroyed. Climatic changes suggested themselves to me, but the present existence of ant villages in the adjoining state of Texas seemed to negative this assumption also.

A number of years afterwards I was forcibly reminded of the inutility of supposing climatic changes to have occurred, when having camped in the Yellowstone valley after nightfall on a convenient elevation above the sodden ground, I was put to precipitate flight by an army of large ants issuing from beneath my rubber mattress. Daylight observation revealed to me the counterparts of the Louisiana mounds, only as a rule less thickly grouped than on the Louisiana prairies; and on excavating some of these mounds which had been deserted by their aggressive inhabitants, I noted precisely the same structureless earth I had seen in the Opelousas prairie, only this time traversed by half-obliterated burrows, which in the Louisiana mound-fields were almost wholly imperceptible, or at least undistinguishable from old root-tracks.

It therefore seems to me that the question of the Louisiana mounds resolves itself into a biological problem, viz., what kind of ant might have built up these elevations, and what causes might have operated to depopulate them. For if mound-building ants now live both in Texas and in Montana, it is hardly necessary to call in climatic changes to account for the facts.

In California there are extensive tracts of similarly appearing mounds (*vulgo* 'hogwallows') in the San Joaquin valley; but here not only can their wind-drift origin be substantiated by ocular demonstration during any of the frequent sandstorms, when the sagebrush clumps are often left two feet above the general level because their roots resist the eroding action by holding the sand; but the wind-drift origin of the general soil surface can mostly be verified, even when, as frequently happens, the bushes thus left 'high and dry' die out in the course of time, and subsequent aqueous erosion increases the height, and a gradual consolidation of the material occurs.

'Hogwallows' of quite different origin occur in Washington, on the gravelly lands south of Tacoma city, *e. g.*, on Yelms prairie. Here, in the land of almost daily heavy rains during certain seasons, water erosion has removed the sand and smaller gravel from variously-shaped areas surrounding one or several larger blocks (erratics), the channels between adjacent mounds being lined with cobbles left behind by the water. Yet while the general aspect of the surface is similar to that of the 'hogwallows' of California and the mounds of the Calcasieu prairie, there is clearly no genetic relation between the three kinds of 'mounds,' however similar in their external conformation.

E. W. Hilgard.

Berkeley, Cal.,
March 10, 1905.

PROGRESS IN THE STUDY OF THE KELEP.

The existence of an efficient insect enemy of the boll weevil having been ascertained, it became necessary to determine also the extent, if any, to which it could be utilized in the United States. Since the last published report on the subject* many additional data have accumulated, but there are three features worthy of special notice.

The Kelep in Western Guatemala.—Recent letters from Mr. W. R. Maxon report the existence of the kelep in the cotton fields of the Retalhuleu district of western Guatemala. Mr. Maxon has also sent to the Department of Agriculture seeds and dried bolls of an upland cotton of a variety evidently similar to that grown by the Kekchi Indians of Alta Vera Paz. The three nectaries inside the bracts appear to be even larger than in the Kekchi cotton. The pair of inner stipular bracts which subtend each of these nectaries are the largest yet known, and have their margins fringed with long hairs, as though to increase their efficiency in holding the nectar to attract the keleps inside the involucre.

This west Guatemalan or so-called *Pachon* cotton is also an annual crop and is said to ripen in five months, or in even less time than the Kekchi. Following the analogy of other plants, these varieties, if they can be acclimatized in the United States, may be expected to mature in a still shorter period, which gives them distinct agricultural interest. The effectiveness of the plan of mitigating the injuries of the boll weevil by cultural means depends upon the shortening, as far as possible, of the growing season of the cotton plant. Other things being equal, a short-season variety will also be an early variety, of course, but the simultaneous planting of quick-growing varieties is likely to prove a better measure of protection than uncertain and desultory early planting, because the weevils are much more likely to perish by starvation after the weather is warm enough to bring them to the condition of activity than while they are kept by the cold in a torpid, hibernating state. It is thus not impossible that these short-season varieties of cotton which are cultivated in Guatemala by the help of the kelep may prove to be of value in the United States, even without their insect guardians. It may be repeated, too, that both of the dwarf, kelep-protected varieties of Guatemala belong to the upland type and produce fiber of good length and quality.

* 'Report on the Habits of the Kelep,' Bull. 49, Bureau of Entomology, U. S. Department of Agriculture, 1904.

Breeding Habits of the Kelep.—The continued study of the kelep in Guatemala, as well as in the United States, makes it possible to outline the breeding habits of the insect, which are in many respects different from those of the true ants, and very much more suited to the purposes of domestication. Popular language affords only the one word 'ants' for all the wingless, social insects. Even the termites are everywhere called 'wood ants' or 'white ants,' though having no affinity or similarity with the true ants apart from their social habits and the winglessness of the worker castes.

The kelep furnishes another chapter of the same kind of history. It has, apparently, little or nothing to do with the true ants. Its social economy does not follow the monarchical system of the ants and termites, but represents an entirely different system, more like that of the honey-bees, in that new colonies are founded by the subdivision of the workers of older communities instead of by solitary queens. The keleps, indeed, have carried the principle of organization a step further than the bees, for they do not depend upon the queen to lead the swarm, but take her by the jaw and carry her over to the new burrow, in case she fails to go voluntarily. The new establishment is also equipped with eggs and larvæ brought over from the old, so that the founding of a new colony does not involve any interruption of the domestic activities. This mobile organization of the keleps suggests to a slight extent the social habits of the nomadic driver 'ants,' and as with these the queens are stationary, and probably never leave the nest except when carried by the workers in migrating to the new home. Males are to be found in the kelep nests throughout the year and cross-fertilization is probably accomplished by the wandering of these from one to another of the closely adjacent, not unfriendly communities. The kelep queens have wings at first, but probably never use them. In some of the related genera the queens are quite wingless, as among the drivers.

Ability to Withstand Cold.—A cold storage experiment made in Washington last August showed that the keleps would be able to withstand low temperatures, and the colonies which have been left in the Texas cotton fields through the winter have lived long enough to show that cold weather is not likely to be the insurmountable obstacle which will prevent the establishment of this species in the United States.

Recent advices indicate, however, that none of the field colonies which have received no food or care of any kind since they were placed in the ground last July will survive to the cotton planting season. A sufficient cause for this mortality is doubtless to be found in starvation, though other contributing factors are apparent, now that the social organization of the insects is better understood. The season has been, as is well known, one of unusual severity, both in drought and cold. The colonies were planted in the fields so late in the season that it seemed necessary to look for the dampest places in order to give them a fair chance to dig, but this has exposed them to special danger from flooding, which appears to have been the immediate cause of death in several instances, and possibly in all. The fields in the vicinity of Victoria, where most of the colonies were located, were completely and repeatedly denuded of their foliage, flowers, buds and young bolls by the leaf worms. Although the keleps readily captured and made use of these when the successive broods were in the larval condition, and even broke into the pupæ, there were intervals when food was almost entirely lacking, and even boll weevils became extremely scarce.

There are also two important social causes of demoralization. The colonies were brought from Guatemala under the impression that the keleps were true ants, and would be able to replenish themselves if the queens were secured. Our artificial nests were mostly very small, no jars of suitable size being obtainable in that part of Guatemala. The complement of workers was, therefore, usually very much below the normal. It has since been learned by repeated observation that the keleps are like the honey-bees, in that the reduction of the colonies below the normal size induces discouragement, dejection and aberration of instincts. Neither did we take pains to include with all the colonies eggs, larvæ and pupæ. The queens lay freely in captivity, but a break in the normal succession of forms may be disastrous, because nurse duty is performed by the young, light-colored workers, the predaceous, hunting instincts appearing with greater maturity. The neglect of the young in some colonies and a frequent tendency to cannibalism may be ascribed to this deficiency of keleps of proper age, though even in colonies otherwise normal some of the larvæ are occasionally killed and fed to the others, especially if there has been a deficiency of other animal food.

Detailed reports on the social organization and other features will be made, but in the meantime it is apparent that a fair experiment to determine whether the kelep can maintain itself in the United States will require the planting of full-sized colonies early in the season, and in sufficient numbers, if possible, to protect the field of cotton from the leaf-worms as well as from the boll weevils. That the kelep is not a true ant, and that its habits differ so greatly from those of any other insects previously known, are facts that show how impracticable it would have been to determine its possibilities in advance by the application of analogies drawn from insects of other families.

O. F. Cook.

New Orleans,
March 16, 1905.

QUOTATIONS.

THE SANITATION OF THE PANAMA CANAL ZONE.

Dr. Charles A. L. Reed, chairman of the legislative committee of the American Medical Association, and lately president of this the representative organization of the medical profession throughout the United States, a man capable in every way of forming just conclusions and with the courage and capacity vigorously to express his convictions, has, at the request of the Secretary of War, submitted a report of the sanitary, or unsanitary, conditions in the Panama Canal Zone and in the towns of Panama and Colon placed by treaty under the management of the United States commission.

If the report of this gentleman is correct, and it must be accepted as such until it is proved that he has made misstatements, the sanitary department of the Panama commission has been in great measure paralyzed by circumlocution and red tape and the misguided interference of those who have been placed in authority over the medical corps. In certain quarters Dr. Reed's report has been classified as 'frenzied' literature; but if one-tenth of the criticisms which he has made were justified sanitary affairs on the Isthmus are in such deplorable shape that the president should compel an immediate change in a disgraceful and dangerous situation.

There is but one commonsense solution of this problem, and sooner or later it will be applied; but the chief magistrate should not wait to take this matter in hand until the graveyards of Panama are filled with the victims of 'red tape.'

As an illustration of the absurd methods employed, Dr. Reed says in substance that if the surgeon in charge of the Ancon Hospital makes a requisition for supplies it must go to the chief sanitary officer for approval, then to the governor of the zone, then to the chief disbursing officer and thence to the commission at Washington. It must there wait for advertised bids, and when the award is made the requisition is filled under the supervision of a purchasing agent, often not properly qualified to select medical supplies. The material is then shipped to the Isthmus, the disbursing officer is notified, he notifies Col. Gorgas, and he in turn must notify the surgeon in charge of the hospital, who then applies to the quartermaster for transportation; and, finally, so much of the material as in the judgment of the governor and chief disbursing officer and the commission ought to be allowed to the superintendent arrives at the hospital.

There are cited numerous other instances of this ridiculous routine which in the light of a recent experience are a reflection upon the intelligence and conscience of the American people.

We refer to Cuba, where Major Reed and Col. Gorgas practically had *carte blanche* to do what in their judgment was best for the sanitation of Havana and Cuba.

The present situation can be remedied satisfactorily in but one way. Col. W. C. Gorgas is known to be one of the most expert sanitarians now living. He is a man whose courage is of that exalted character which scorns personal danger, a man of integrity, of executive ability and worthy of the fullest confidence of the government. Why not repeat the experience of Cuba in Panama? Why go back to the old methods of crippling the usefulness of the Army Medical Corps by permitting it to be blocked by circumlocution or entangled in the meshes of red tape until it might almost as well not exist?

The people of the United States will oppose the president's removal of the present commission, and if he will go further and put an end to this dangerous condition of affairs by placing Col. Gorgas in full authority in all matters pertaining to sanitation he will deserve still greater credit. In the construction of the Panama Canal the question of sanitation is paramount.—The N. Y. *Sun*.

BOTANICAL NOTES.

A HELPFUL BULLETIN.

The office of Experiment Stations of the United States Department of Agriculture has issued a Bulletin (No. 2) consisting of an outline of a lecture on 'Potato Diseases and Their Treatment' for the use of farmers' institute lecturers. It was prepared by F. C. Stewart and H. J. Eustace, of the New York Experiment Station. It contains summaries of our knowledge of the most important diseases which affect the potato in the United States. The descriptions are given in non-technical language, and ought to convince every botanist of the possibility of treating quite difficult subjects in plain English. Following the description of diseases is an admirable chapter on spraying and other preventive measures. A very useful bibliography is added in an appendix.

SEASIDE LABORATORIES.

It is a fortunate thing for the scientific students of America that year by year the opportunities for seaside study are more common and easily accessible. Some of us remember the time, not so very long ago either, when Agassiz's laboratory on Penikese Island was the only place where seaside studies were possible under competent guidance and supervision. The Penikese laboratory has long since ceased to be—on the death of its illustrious founder it could not secure adequate support. It died, and men spoke of it as another visionary project which had met with the usual fate of an early death after a brief and fitful existence. But although that project died, others have arisen to more than take its place. To-day laboratories that include the essential features of the one founded by Agassiz are not uncommon on both coasts of the United States, as well as on the shores of our inland waters.

The eighteenth session of the Marine Biological Laboratory at Woods Hole, Mass., is of interest to the botanist not only on account of the botanical courses offered, but also because this is to a certain extent the lineal descendant of the Penikese laboratory whose abandoned site is but a few miles away. As heretofore, the work in botany is to be under the direction of Professor Doctor Bradley M. Davis, of the University of Chicago.

There are the usual opportunities for investigation for advanced students, and regular instruction in the morphology of thallophytes, cytological studies and plant physiology. The laboratory is open for investigation from June 1 to October 1, and for instruction from June 28 to August 9.

On the west coast of Vancouver Island, at Port Renfrew, twenty-six hundred miles from the Woods Hole laboratory, is the Minnesota Seaside Station, whose fifth session is announced for the present year, under the directorship of Professor Conway MacMillan, of the University of Minnesota. Although so far away from the pioneer Penikese laboratory, this one on Vancouver Island is filled also with the spirit of the master who taught us to study nature out of doors. Here, in addition to opportunities for investigation, botanical courses are offered in algology, lichenology, bacteriology, taxonomy of the Coniferæ and nature study. The session begins July 8 and closes August 18.

It is interesting to compare these two marine stations—the first on the New England mainland, looking across to Martha's Vineyard, and the Elizabeth Islands, with the interesting flora of the north Atlantic coast, rich in many red seaweeds; and the second on the shore of Vancouver Island, looking out across the Strait of Juan de Fuca, to Cape Flattery, and the Olympic Mountains of the northwest corner of Washington. Here the marine flora is especially rich in the great kelps so characteristic of the Pacific coast of North America.

UTAH FUNGI.

Some months ago Mr. A. O. Garrett, of Salt Lake City, issued the first fascicle of twenty-five numbers of Utah fungi under the title of 'Fungi Utahenses.' This fascicle is devoted to the Uredineæ, and it is the author's intention to follow this plan in succeeding issues, so that each will contain specimens belonging at least to closely related groups. Mr. Garrett has modeled his collection upon the pattern so well set by Professor Kellerman in his 'Ohio Fungi.' The specimens are carefully selected, and neatly put up. Each species is accompanied by a reprint of the original description. This distribution should have a large sale, especially among eastern botanists.

PHOTOGRAPHS OF VEGETATION.

Two years ago the first fascicle of an important work was issued by Gustav Fischer, of Jena, under the simple title of 'Vegetationsbilder.' Since then nine fascicles have appeared, and it is now possible to judge quite accurately in regard to its usefulness. The work is edited by Professor Doctor G. Karsten, of the University of Bonn, and Professor Doctor Schenck, of the Technical High School of Darmstadt. Each fascicle includes six large reproductions (16 by 21 cm.) of photographs of vegetation, each accompanied by a page or two of explanatory text. The first fascicle is devoted to the vegetation of southern Brazil and is the work of Dr. Schenck. The second fascicle, by Dr. Karsten, illustrates the vegetation of the Malayan Archipelago; the third is again by Dr. Schenck, who takes up some economic plants of the tropics, as *Thea sinensis, Theobroma cacao, Coffea arabica,* etc. Fascicle 4, devoted to tropical and subtropical Mexican vegetation, is edited by Dr. Karsten, while the next, relating to southwest Africa, is from the hand of Dr. Schenck. In the latter the most remarkable is Plate 25, showing a desert, with several plants of *Welwitschia mirabilis* in the *foreground.* The sixth fascicle, by Dr. Karsten, contains photographs of six species of monocotyledonous trees, including one plate of a giant bamboo clump (*Dendrocalamus giganteus*) forty meters high, on the island of Ceylon. Six views of Brazilian strand vegetation, by Dr. Schenck, make up the seventh fascicle, and another half dozen devoted to Mexican cactuses and agaves (by Dr. Karsten and Dr. Stahl) make up the eighth fascicle which closes Series I. of the publication. The second series opens with a fascicle by E. Ule, on Amazonian epiphytes, in which the illustrations and text maintain the high degree of excellence of the first series.

It is to be hoped that this most useful publication will be continued until the vegetation of the more important parts of the world have been depicted and described. It certainly fills a place in the botanist's library that has not hitherto been occupied.

Charles E. Bessey.

The University of Nebraska.

SCIENTIFIC NOTES AND NEWS.

We regret to learn that Lord Kelvin is ill after a surgical operation.

A statue of Professor Conrad Röntgen has been placed on one of the bridges in Berlin.

Professor Wilhelm Ostwald, the eminent physical chemist of Leipzig, will again this year take part in the work of the summer school of the University of California.

Dr. Frank Schlesinger has been elected director of the New Allegheny Observatory, and assumed the duties of the office on April 1. The observatory has an endowment fund, and a regular income from the time service, besides owning a large and valuable property in the City of Allegheny, which will become a source of income in the near future. Work has not been suspended on account of lack of funds and much has been accomplished toward the instrumental equipment during the year past. The Keeler Memorial Telescope of 30 inch aperture is now ready to be set up, and the large (Porter) spectroheliograph is almost completed. The 30 inch objective is well under way, and other instruments will be installed during the year under the directorate of Dr. Schlesinger.

Owing to the appointment of Dr. C. H. Wind, director of the Dutch Meteorological Institute, to a professorship in the University of Utrecht, Dr. E. Van Everdingen has been made acting director of the institute.

The Academy of Sciences of St. Petersburg has awarded its Lomonsoff prize to Professor N. A. Menschutkin for his researches in theoretical chemistry and its Ivanoff prize to Professor P. N. Lebedeff, of Moscow, for his work on light pressure.

The French Société d'encouragement pour l'industrie nationale has awarded the Lavoisier medal to M. Héroult in recognition of his electrometallurgical researches.

The Leopoldo-Carolinische Akademie of Halle has awarded the gold Cothenius medal to Professor E. von Leyden, of Berlin, for his services to scientific medicine.

Aberdeen University will confer the Doctorate of Laws on Mr. J. T. Merz, author of 'European Thought.'

The thirteenth 'James Forrest' lecture of the British Institution of Civil Engineers will be delivered by Colonel R. E. B. Crompton on April 10, on 'Unsolved Problems in Electrical Engineering.'

Professor Richard Andree, the ethnologist and geographer, long editor of *Globus*, has celebrated his seventieth birthday, in Munich.

Professor Francis E. Lloyd, Teachers College, Columbia University, has received a grant of $500 from the Carnegie Institution to aid him in continuing his studies on stomatal action and transpiration in desert plants. He will spend three months at the Desert Botanical Laboratory, Tucson, Ariz., for this purpose.

Dr. Alfred Ernst, associate professor of botany at Zurich, has been given the Swiss subvention of $1,000 for botanical studies at Buitenzorg.

A memorial tablet for the late Dr. N. S. Davis was presented by the senior medical class of the Northwestern University Medical School, on March 24, in Davis Hall.

We regret to record the death of Dr. Emmerich Meissl, section chief in the Department of Agriculture at Vienna; of Dr. Richard Sadebach, director of the Botanical Museum at Hamburg, and of Father Timoteo Bertelli, the Italian geophysicist.

There will be on May 3 and 4 a civil service examination for topographic draftsman in the Panama Canal work, at salaries of from $900 to $1,500.

To secure promptness in the delivery of the reference cards issued by the Concilium Bibliographicum of Zurich, Dr. H. H. Field has placed a stock series in the American Museum of Natural History. Any worker in biology, who does not receive the cards directly from Zurich, by writing to the museum will receive by return mail cards bearing upon such minor subjects as he may indicate, at the same terms as though the delivery were made from Zurich, and with an obvious saving of considerable time. Communications bearing upon this matter should be addressed to the American Museum of Natural History, Department of Books and Publications.

Oxford convocation has passed a decree authorizing the contribution by annual instalments of a sum not exceeding £1,000 towards the expense of printing that portion of the British Section of the International Astrographic Catalogue, which has been carried out at the University Observatory, the Treasury, on the representations of the Royal Society, contributing the other moiety.

Mr. Alexander Fry has bequeathed his entomological collection to the British Museum of Natural History.

Nature states that the collection of birds' eggs possessed by the British (Natural History) Museum has been largely augmented by the gift of the splendid series brought together by Mr. W. Radcliff Saunders, of High Bank, Tonbridge. This collection comprises close on ten thousand specimens of the eggs of Palearctic species, together with one hundred and sixty-five nests.

The Crosby Brown collection of musical instruments, in the Metropolitan Museum of New York, to which we have several times referred in recent years, continues to grow. The recently published new edition of the catalogue of European instruments is increased over the previous edition by more than fifty pages and three plates. The total number of instruments is given as about 3,200, besides hundreds of parts illustrating elements and details of construction.

Reuter's Agency reports some details of an expedition which went to British New Guinea in September, 1903, and has lately returned to England. The expedition was organized by Major W. Cooke-Daniels, an American traveler, and it also included Dr. C. G. Seligmann, Dr. W. M. Strong and Mr. A. H. Dunning. The objects were primarily ethnographical, but studies were also made in other branches of science, and a number of general pathological observations were made.

The annual dinner of the British Institution of civil engineers took place on March 22, with Sir Guilford Molesworth in the chair.

The sixth International Congress of Applied Chemistry will be held at Rome next year, probably during the week following Easter.

At the last International Ornithological Congress, which was held in Paris in 1900, it was decided that the next session of the congress should take place in London after an interval of five years, and, as we have already announced, arrangements have been made for holding the fourth congress from June 12 to 17, under the presidency of Dr. Bowdler Sharpe, of the British Museum. The London *Times* states that it has been decided by the organizing committee to divide the congress into general meetings and meetings of sections, of which there will be five, as follows: (1) Systematic Ornithology; Geographical Distribution, Anatomy and Paleontology; (2) Migration; (3) Biology, Nidification, Oology; (4) Economic Ornithology and Bird Protection; and (5) Aviculture. It is expected that many interesting papers on these various subjects will be forthcoming. The social side of the program is not being neglected. Thus it is proposed to devote one day to an excursion to Tring to inspect the collection of birds belonging to Mr. Walter Rothschild. On this occasion there will be lectures, and the members will be the guests of the owner of the Tring Museum. On the 16th of June the congress will be received by the Lord Mayor of London at the Mansion-house, and the visitors will be shown over the Guildhall by Alderman Treloar. At the close of the proceedings in London, on the invitation of the Duke of Bedford, an excursion will be made to Woburn to view the collection of live animals in Woburn Park, and the following day will be spent at Cambridge, where Professor Newton will welcome the members at Magdalene College. Finally, a journey has been planned to Flamborough Head, in Yorkshire, of special interest to continental ornithologists, as affording them an opportunity of seeing the breeding place of so many sea birds, while the season of the year may also allow of their watching the operations of the collectors of the eggs of the guillemats.

An international exhibit of hygiene will, by request of the Italian general health department, be added to the exhibition at Milan, 1906. Many countries will assist in the display, which will have for its object the presentation in a practical manner to the public of the advances made in the field of sanitation during recent years.

Medical journals state that the Hamburg-American line has placed the *Hamburg* at the disposal of the German physicians and their families who wish to attend the International Medical Congress at Lisbon next year. The vessel will be moored at some convenient wharf and will serve as a hotel for the passengers during the congress. After a brief trip to Gibraltar and Madeira the vessel will return to Hamburg. Messrs. Cook & Son have offered to charter a passenger ship for the English members of the congress, to serve as a floating hotel.

WE learn from *The British Medical Journal* that the proceedings of the Pan-American Medical Congress, held at Panama in January, closed with a meeting of the executive committee at which the following resolutions, proposed by Guatemala and seconded by Peru, were carried: (1) That the next Pan-American Medical Congress arrange (*a*) for an international American pharmacopoeia; (*b*) for an international code of sanitation; (*c*) for an international code on temperance; and (*d*) as a sequel to the above, for the establishment of sanatoriums for the treatment of alcoholism; (*e*) for the formation of lectureships on medicine in the required studies of jurisprudence. (2) That there be formed at the next congress a section on tropical diseases. (3) That there be created Red Cross Branches, both civil and military. (4) Finally, it was resolved that encouragement be given to those engaged in the campaign against tuberculosis.

Nature states that after an interval of two years the fifth conference of West Indian agriculturists was held at Port-of-Spain, Trinidad, from January 4 to 13. It was attended by official, scientific, commercial and practical representatives from all parts. In his presidential address, Sir Daniel Morris gave an interesting survey of the great economic change which is in progress. Taken in the aggregate, sugar cultivation must still be regarded as the backbone of the colonial industries, but in some of the islands it has already become of comparatively little or no importance. Trinidad is now a cacao-producing island, its exports of this commodity having risen to the value of a million sterling per annum. Grenada's cacao exports are valued at £250,000 and Jamaica's at £80,000. Cotton growing, too, has been successfully re-established in several islands, and remunerative prices for the raw cotton are being obtained from Lancashire merchants. The exportations of fruit far exceed in value those of the staple industry. The development of the tobacco, rubber, sisal hemp, fish-curing, and other industries also came under review, and Sir Daniel dwelt upon the importance of agricultural shows and on the provision made by his department for teaching elementary science and the principles of agriculture in the various colleges and elementary schools. Numerous papers were read and discussed, Professor d'Albuquerque, Dr. Watts, Professor Harrison and others supplying valuable information relating to sugar; Mr. Hart, Mr. de Gannes and others, on cacao; Mr. Bovel, Mr. Sands and others, on cotton; and so on. For practical purposes visits were paid to several cacao and sugar estates. Owing to its more than usually representative character the conference is declared to have been the most successful of the series.

UNIVERSITY AND EDUCATIONAL NEWS.

THE New York *Times* states that Mr. Carnegie since 1900 has given $2,000,000 for libraries and $4,500,000 for other buildings and endowments for colleges. The following is a list of institutions to which the money has been given:

Pennsylvania State College	$150,000
Upper Iowa University	25,000
Oklahoma University	30,000
Iowa College	50,000
Tuskegee Institute	20,000
Beloit College	50,000
Cornell College	50,000
Mt. Holyoke College	50,000
Yankton College	15,000
Talladega College	15,000
N. C. State Normal and Industrial..	18,868
Lebanon Valley College	20,000
Wilberforce University	15,000
Bucknell University	30,000
Berea College	30,000
Agricultural and Mech. College ...	12,000
Winthrop Normal and Ind. College.	30,000
Washburn College	40,000
Converse College	10,000
Benedict College	6,000
Park College	15,000
Atlanta University	25,000
Tufts College	100,000
Lawrence University	50,000
Marietta College	40,000
Oberlin College	125,000
Fairmount College	40,000
University of Maine	50,000
Bethany College	20,000

North Dakota Agricultural College.	15,000
Simpson College	10,000
Carson & Newman College	10,000
Central University of Kentucky	30,000
Earlham College	30,000
Fessenden Academy	5,000
Fisk University	20,000
Furman University	15,000
State Normal School	10,000
Heidelberg University	25,000
Juniata College	15,000
Livingstone College	12,500
Pomona College	40,000
Syracuse University	150,000
University of Mississippi	25,000
University of Tennessee	40,000
Washington and Lee University	50,000
De Pauw University	50,000
University of North Carolina	50,000
Alabama Polytechnic Institute	30,000
Drake University	50,000
St. John's College	16,700

During the past week a gift of $100,000 to Rochester University for the construction of a scientific building and $50,000 to Norwich University, Vermont, half for a library and half for an engineering department, have been announced.

IT is announced that a gift of $250,000 has been made to Northwestern University by Milton H. Wilson, a resident of Evanston, and one of the trustees of the institution.

THE London *Times* states that further papers have been published by the government of India in respect to the late Mr. Jamsetjee N. Tata's offer of an endowment in the shape of properties valued at £200,000 for the creation of an Institute of Indian Research at Bangalore. Certain conditions in respect to government assistance were attached to the offer, which was first made six years ago, and these have been the subject of prolonged discussion and correspondence between the government, Mr. Tata during his lifetime, and his representatives. The papers now published show that the difficulties in the way of a settlement have been removed. Guarantees have been offered by the representatives of the donor to secure the full income estimated from the endowment properties, and the management of the latter is vested in a board whose chairman is to be an officer selected by the Bombay government. In addition to making a grant of 2½ lakhs of rupees (£16,666) towards the construction of the necessary buildings and provision of scientific apparatus, the government will make an annual grant to the institute of half the local assets up to a limit of 1½ lakhs of rupees, provided that the institute is conducted on lines approved generally by the government.

THE Barney Memorial Science Hall of Denison University was completely destroyed by fire at two o'clock A.M., March 30. The building was erected in 1894 at a cost of $45,000, and the value of the equipment within it was also about $45,000. The department of chemistry, in which the fire started, suffered total loss. The department of physics, which had installed several thousand dollars worth of new apparatus this season, lost most of its equipment, including the greater part of the manuscripts and instruments of the researches of Professor C. W. Chamberlain. The equipment of the department of geology, including about $7,000 worth added this year, was nearly all saved. The departments of zoology and botany saved about half of their equipment. There is about $40,000 insurance on the building and contents, and the hall will be rebuilt at once. The most serious loss is the scientific library which has been accumulated during the past twenty years, chiefly through exchange with Denison publications and which was one of the richest collections of society transactions and similar serials in the middle west. In making good, so far as possible, this severe loss the generous cooperation of authors and learned societies is requested. Authors' separates, duplicates, or society publications, if sent to the permanent secretary of the Denison Scientific Association, Granville, Ohio, will be gratefully accepted as a nucleus of a new library.

REV. FREDERICK W. HAMILTON, D.D., pastor of the First Universalist Church of Roxbury, has been elected temporary president of Tufts College, to fill the vacancy caused by the death of President Capen.

MR. R. P. GREGORY, M.A., of St. John's College, has been appointed senior demonstrator in botany at Cambridge.

SCIENCE

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FRIDAY, APRIL 14, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

PENETRATING RADIATION ASSOCIATED WITH THE X-RAYS.

As the following investigation is made with the aid of nuclei, certain of their properties bearing on the present subject will first have to be specified. Exhaustions are preferably made at a pressure difference (δp) just below the point (to be called *fog limit*) at which dust-free non-energized saturated air condenses without foreign nuclei. δp depends on the particular apparatus used.

1. *Fleeting Nuclei.*—Let the X-radiation to which the dust-free air is exposed be relatively weak, so that the density of ionization may remain below a certain critical value. The nuclei observed on condensation are then very small and they require a high order of exhaustion, approaching the fog-limit of non-energized air. They are usually instantaneously generated (within a second) by the radiation, so that their number is definite independent of the time of exposure. They decay in a few seconds after the radiation ceases; *i. e.*, roughly to one half their number in two seconds, to one fifth in twenty seconds in the usual exponential way. I fancy that these nuclei are what most physicists would call ions; but nevertheless the particles are not of a

size, their dimensions depending on the intensity of the penetrating radiation to which they are usually due; and they pass continuously into the persistent nuclei as shown in the next paragraph, where decay of ionization and of nucleation are very different things. Finally (§ 3) they are stable on solution. The case seems rather to be one in which the rate of decay exceeds the rate of production. The following is an example of data bearing on this case, N being the number of nuclei caught per cubic centimeter. The anticathode is at a distance from the fog-chamber and the exhaustion carried to the verge of the fog-limit of dust-free air.

Time of exposure: (rays on)	0	5	15	30	60	120 secs.
$N\times 10^{-3}$	*1.6	74	74	—	74	—
Time after exposure: (rays off)	0	5	15	30	60	120 "
$N\times 10^{-3}$	92	30	23	18	10	4

The two series refer respectively to generation and to decay.†

2. *Persistent Nuclei.*—If the X-ray bulb is approached nearer the fog-chamber or if a more efficient bulb is used so that the density of the ionization within the fog-chamber is sufficiently increased, the rate of production of nuclei will eventually exceed the rate of decay. The nuclei are now persistent for hours after the radiation ceases. The number N per cubic centimeter increases in marked degree and at an accelerated rate with the time of exposure to the radiation, certainly for ten minutes or more, barring the invariable loss of efficiency of the X-ray bulb. These nuclei are large, requiring very little supersaturation for condensation and are much like any ordinary nuclei. They are pronouncedly of all sizes and the initial coronas are apt to be distorted and stratified beyond recognition. Whirling rains and fog accompany the first condensation. While small nuclei occur throughout the chamber, the end near the bulb is at first the seat of growth which gradually extends to the other end, as I have shown elsewhere.* The following two series of data showing the generation and decay of nuclei in question may be cited as illustrations. The pressure difference $\delta p = 20$ cm., much below the fog-limit for dust-free air, in the given apparatus.

* Fog limit of dust-free air just exceeded.

† Including loss by diffusion or other time-loss.

Time of exposure......	0	5	10	20	60	120	180 secs.
$N\times 10^{-3}$	0	2	11	10	20	†(100)	†(500)
Time after exposure ..		0	36	85	240 minutes.		
$N\times 10^{-3}$		†(100)	36	20	vanishing.		

Hence there is a decay of one half in ten minutes, and to one fifth in eighty minutes, or the degree of persistence is 200–300 times larger than in the first paragraph. The data indicate, moreover, that both of these extreme types of nuclei and all intermediate types now occur together, as may be tested by changing the pressure difference, δp, on exhaustion. Intermediate rates of generation and decay may be obtained by moving the bulb nearer to or farther from the end of the fog chamber. Finally the rates at which the nuclei and the ionization severally decay, between which it would be difficult to distinguish in the case of the very fleeting nuclei, stand in sharp contrast with the persistence of the nuclei of the present paragraph.

3. *Fleeting Nuclei Become Persistent on Solution. Origin of Rain.*—Let the fog-chamber be exposed to radiation for a few seconds and thereafter exhausted ($\delta p = 25$) as usual. Closing the exhaustion cock and allowing only time enough to measure the first corona, let the influx cock be opened and the fog-chamber be refilled with dust-free air. The (primary) corona observed is thus dispelled before much subsidence of fog-particles can take place, though the rain will naturally drop out. If the fog-chamber is now left without interference

* *American Journ. Sci*, XIX., 175.

† Computed from the second exhaustion, after subsidence of the dense fogs of the first.

(the radiation having been cut off immediately after the first exhaustion) for one or more minutes or longer, a second exhaustion to the stated limits will show a large (secondary) corona relatively to the primary corona. In other words, relatively many of the fleeting nuclei or ions caught in the first fog have persisted, whereas without condensation, they would have vanished at once after the radiation was cut off. The following is an example of data bearing on this point, t denoting the time elapsed from the evaporation of the first corona to the precipitation of the second, N_1 the number of nuclei in the first and N_2 the number in the second corona.

$t=$	60	120	300 seconds.
$N_1 \times 10^{-3}=$	53	27	53
$N_2 \times 10^{-3}=$	16	7	15

The experiments are complicated by the variable X-ray bulb; but it is obvious that while all the nuclei would have vanished in a few seconds without condensation, about one fourth (in other experiments more) persist indefinitely if reevaporated after condensation from fog-particles.

This result has an important bearing on the whole phenomenon of condensation and nuclei. Clearly the latter, after the evaporation specified, become solutional or water nuclei, in which the original fleeting nucleus or ion behaves as a solute. The decreased vapor pressure due to solution eventually compensates the increased vapor pressure due to curvature, after which at a definite radius, evaporation ceases and a water nucleus results. Such a nucleus, however small, must be large in comparison with the dissolved ion. Hence on condensation the water nuclei will capture the moisture soonest and grow largest. Now in any exhaustion about one eighth of the fog particles, *i. e.*, those which are smallest and whose nuclei have been caught at the end of the exhaustion, regularly evaporate into the larger particles to a residue of water nuclei. These are then the first to be caught in a succeeding exhaustion. This is the explanation of the *rain* which not only accompanies all coronas in dust-free air, but is often dense. It is also an explanation of those indefinite alternations of large and small coronas (periodicity) which I described in detail elsewhere.

4. *Secondary Generation.*—This is a curious phenomenon, showing that the decaying nucleus is apparently radioactive, or that the walls of the fog-chamber are so, or else that the large nuclei if left without interference break into a number (on the average about three) of smaller nuclei, whereby the nucleation is actually increased in the lapse of time after exposure. In other words, if the nucleation is observed without cutting off the radiation in one case, and if in the second case the nucleation identically produced is observed at a stated time after the radiation has ceased, the number in the latter case (anomalously enough) is in excess. The following examples make this clear, the X-ray bulb being 5 cm. from the fog-chamber, and the exhaustion carried to $\delta p=20$ cm.

Rays on	2	2	2	2	2	2	2	2	2 minutes
Rays off	0	4	0	4	0	2	0	20	0 "
$N \times 10^{-3}$	20	52	20	32	25	30	13	34	30

These data are computed from the second exhaustion, as the first show the densely stratified fogs unavailable for measurement. With the bulb at different distances from the fog-chamber, the following data admit of the same interpretation.

Distance, $D=$	5	10	15	5	10	15 cm.
Rays on	2	2	2	2	2	2 minutes.
Rays off	0	0	0	0	0	0 "
$N \times 10^{-3}$	22	3	1	58	9	1

The phenomenon vanishes when the radiation is too weak to produce persistent nuclei, therefore either when the bulb loses efficiency or when it is too far from the fog-chamber. These results recall the corresponding behavior evoked by radium in sealed tubes, specified in my last article.* See § 6.

5. *Space Surrounding the X-ray Tube a Plenum of Radiations.*—While the phosphorescence, photographic and electric effects of X-radiation decreases rapidly with the distance D from the tube, the nucleating effect (N nuclei generated per cubic centimeter, instantly) is nearly constant over relatively enormous distances.† Thus to give an example among many ($\delta p = 25$ cm.):

$D =$	6	200	600	6	200	600 cm.
$N \times 10^{-3}$	88	83	83	79	79	79

The law of inverse squares would predicate a reduction of 10,000 to 1 between these limits; and in fact at 6 cm. the phosphorescent screen is intensely luminous, at 200 cm. very dim, at 600 cm. quite dark, as in the case of any ordinary illumination. The leaves of an electroscope within a glass bell-jar collapse in a time which is directly as the square of the distance from the energized X-ray bulb. The result obtained with nuclei is astonishing; the nuclei-producing radiation would at first sight seem to be of an extremely penetrating kind, akin to the gamma rays of radium and distinct from the ordinary phosphorescence-producing X-rays. This impression is accentuated by the fact that the radiation can not be stopped by lead screens many centimeters in thickness, placed between bulb and fog chamber. The following are typical examples, in which the distance between the lead plates screening the fog chamber and the X-ray tube is $D = 600$ and 200 cm., respectively. N shows the number of nuclei instantly generated behind the plates in the two cases.

Thickness of lead screen	0	.14	.28	.56	.84	1.12	0 cm.
$N \times 10^{-3}$	67	28	28	31	29	31	76
$N \times 10^{-3}$	79	44	48	41	—	44	70

Again the X-ray tube apparently emits this radiation forward as well as rearward, as if the thin anticathode were quite pervious. I found, for instance, for the radiation of the anticathode at 6 meters from the fog chamber,

from the front face (tube directed), $N \times 10^{-3} = 42$
from the rear face (tube reversed), $N \times 10^{-3} = 35$,

or 81 per cent. of the former apparently issues from the rear face. Even the reversal of the current does not stop the radiation, for about 16 per cent. of the normal intensity is still radiated when the concave mirror is made the anode.

The total efficient radiation may be reduced to a limit by lead screens a few millimeters in thickness or less; thereafter it can not be further reduced by lead screens many centimeters in thickness. For instance, when the radiation comes from 600 cm., a single lead plate (thickness .14 cm.) is more than sufficient to reduce the effective radiation to a minimum, which amounts to (somewhat less than) one half of the total intensity, at least when estimated in terms of the number of nuclei produced. If the nucleation comes from 200 cm., one plate has the same effect, even though a thickness of 400 cm. of air has been removed. The thickness, .14 cm., is more than enough to reduce the radiation to the limit in question. This again amounts to a little more than one half the total intensity. At a distance of 5 centimeters no more plates may be needed; but the conditions are now too complicated to be described here, chiefly because persistent nuclei are producible. Moreover 80 per cent. of the total intensity may ultimately escape absorption. Thus the rays from different distances behave alike for the more pervious media (§ 5), and in relation to very dense screens.

* SCIENCE, XXI., 275.

† Supposing that the fog-chamber is not enclosed in impervious metal. In the latter case, with the lead covering open towards the X-ray bulb only, there is constancy of N within 20 per cent. over 6 meters.

6. *Lead-Cased Fog-Chamber.*—To interpret these surprising results it will be necessary to surround the fog-chamber with a casket of lead, having a lid on the side fronting the X-ray bulb; for even though the lead plates above may efficiently cut off the primary rays, they would leave the secondary radiation free to enter laterally through the broadsides of the fog-chamber. When this was done the results reduced the penetrability of lead to a more reasonable figure as may be seen from the following example of results when the distance between bulb and fog-chamber was 2 meters.

Thickness of lead penetrated	= 0	.14	.28	.42	cm.
$N \times 10^{-3}$	= 77	10	7	5	

i. e., 14, 9 and 7 per cent. of the total intensity passes one, two and three plates respectively. A glass plate 7 mm. thick and an iron plate .5 mm thick allowed about 90 per cent. to pass, when the casket was left open and the lead plate placed near the bulb 17 per cent. of the total radiation was effective, the excess being of secondary origin. The passage through a plate of tinned iron may be observed for a bulb 6 meters distant as follows:

Thickness of plate	0	.05	.10	.20	cm.
$N \times 10^{-3}$	36	28	11	7	

It follows then that in the above examples (§ 5) nearly one half of the total radiation was derived from secondary sources since the primary radiation was certainly stopped off to within 10 per cent. by the lead plates. To the eye of the fog-chamber, therefore, the walls of the room are aglow with radiation, and no matter in what position the bulb may be placed (observationally from 6 cm. to 6 m. between bulb and chamber), the X-illumination as derived from primary and secondary sources is constant everywhere. It is to be understood that the 'X-illumination' here referred to may be corpuscular. In fact, so far as I see, the primary and secondary radiation here in question may be identical; for the corpuscles may come from the circumambient air molecules shattered by the shock of gamma rays. The latter would in turn be traceable to the atomic disintegration of the anticathodal platinum while under bombardment by the cathode torrent.

The fog-chamber, if open at the end toward the bulb, shows the same total intensity; but in such a case the inner walls of the casket, etc., become the source of secondary rays. The closed lead casket, however, sometimes introduces a discrepancy, for the coronas on second exhaustion are fainter, but nearly as large as on the first. Hence the lead itself is radioactive or it becomes so after becoming energized by the X-rays. This recalls § 3 on the behavior of radium in the sealed tubes as specified in my last paper.

7. *Ordinary Dust-free Air an Aggregate of Nuclei.*—The steam jet shows that nuclei of small relative size, but, nevertheless, large as compared with the molecules of air must normally be present in dust-free air: for the axial colors may be kept permanent at any stage by fixing the supersaturation. Such nuclei may be called colloidal molecules. Moreover, the available nuclei to be reckoned in millions per cubic centimeter increase with enormous rapidity with the supersaturation, in proportion as the molecular dimensions are approached. But even when the yellows of the first order vanish, condensation probably still takes place on the colloidal molecules specified. It is natural to associate these extremely fine nuclei with the existence of a very penetrating radiation, known to be present everywhere. Moreover, the occurrence of many nuclei with but few ions is not contradictory, if the latter are only manifest when the former are made or broken.

8. *Conclusion.*—It has been shown that for very short exposures (§ 3), the nuclea-

tion is the same, whether the bulb is placed at 6 cm. or 6 m. from the fog-chamber. But only in the former case ($D = 6$ cm.) is the effect cumulative; only for very short distances will persistent or large nuclei appear if the exposure is prolonged several minutes. I have, therefore, suspected that the radiation from the X-ray bulb is twofold in character, that the instantaneous effect (fleeting nuclei) is due to a gamma-like ray quick-moving enough to penetrate several millimeters of iron plate appreciably even for $D = 6$ meters; furthermore, that the cumulative effect (persistent nuclei) is due to X-light properly so called, which produces the usual effects subject to the law of inverse squares.

Carl Barus.

Brown University,
Providence, U. S. A.

THE BIOLOGICAL LABORATORY OF THE BUREAU OF FISHERIES AT WOODS HOLE, MASS. REPORT OF WORK FOR THE SUMMER OF 1904.*

The laboratory was opened to investigators on the fifteenth of June, and continued in operation until near the close of September. During the whole or a part of this period twenty-eight investigators were engaged in work upon problems of marine biology. A brief statement of the special subjects of research will be given below.

I. EQUIPMENT, STAFF, ETC.

The same portions of the station were occupied as during the preceding season, and need not again be detailed; the steam vessels *Fish Hawk, Phalarope* and *Blue Wing* were in service during the whole or a part of the season; the zoological library of Brown University was again generously placed at the disposal of the laboratory. Two fish pounds were set, one being placed, as formerly, in Buzzards Bay, not far from the station, the other being planted at No Mans Land, a small island a few miles to the south of Marthas Vineyard. Here a camp was located, several assistants being detailed to tend the trap for a period of about seven weeks.

The staff of the laboratory, for the past season, consisted of a director and seventeen assistants, together with a matron, two janitors and a chambermaid. To this list should be added a clerk and a collector, permanently attached to the station, and the crews of the various vessels. Of the assistants, three had immediate supervision of certain branches of the survey work; three others had charge respectively of the library, the supply room and the fish traps; while the remaining eleven rendered various services in the laboratory or in the field. Mention should also be made here of seven salaried investigators, employed by the bureau to conduct independent researches.

The plan of having a 'seminar' or research club, for the discussion of work in progress at the laboratory, was successfully continued, some of the meetings being largely attended by outsiders, as well as by investigators at the station.

II. BIOLOGICAL SURVEY.

The biological survey of the neighboring waters, commenced during the preceding season, was actively continued. The *Fish Hawk* was at the disposal of the laboratory for some five weeks, during which period she was chiefly engaged in dredging work in Buzzards Bay. In all 66 'stations' were dredged by this vessel, these being located at regular intervals over the bottom of the entire bay. The supervision of this branch of the work was intrusted to Mr. Leon J. Cole. Dredging in Vineyard Sound was likewise continued. A number of the stations (18) of the preceding year were again located and dredged, but the principal work

* Report to the Commissioner of Fisheries by the director of the laboratory.

in the sound was done in the shallower waters near shore. Here the *Phalarope* was employed on account of her lighter draught. This vessel was specially equipped for the purpose at the commencement of the season; a large movable platform being built and a derrick erected. Mr. R. C. Osburn supervised, for the most part, the dredging operations of the *Phalarope*. Seventy-seven 'stations' were dredged, completing the coast line of Vineyard Sound, upon both sides. Dr. Bradley M. Davis, assisted by Miss Lillian MacRae, directed the collecting and identifying of the botanical material secured.

Systematic records were of course kept of all species found in the dredge. As far as possible, identifications were made in the field or in the laboratory, but much material was preserved for reference to specialists. During the preceding winter, many of the species taken during the summer of 1903 had been determined by various experts, and this collection has now been added to the laboratory's museum of local fauna, where it has already proved to be of great assistance in the task of identifying new material. Thanks are due to the following zoologists for the identification of the 1903 material: Professor C. C. Nutting (hydrozoa), Dr. W. R. Coe (nemerteans), Dr. J. P. Moore (annelids), Professor H. L. Clark (echinoderms), Dr. S. J. Holmes (amphipods), Dr. A. E. Ortmann (schizopods), Dr. Harriet Richardson (isopods), Dr. B. W. Evermann (fishes); and to the staff of the U. S. National Museum, for the determination of the molluscs and of several groups of crustacea. The task of identifying the tunicates has been undertaken by Professor W. E. Ritter, the barnacles by Professor M. A. Bigelow, and the bryozoa by Miss Alice Robertson. Thus far it has not been found possible to make any satisfactory disposition of the sponges.

As usual much general collecting was carried on by Mr. Vinal Edwards and others, the material thus obtained being turned over to investigators at the laboratory or preserved for future determination. Mr. Edwards kept his customary records of the fishes taken by trap or by seine.

During the present winter the task of compiling the results of the past two summers' dredging has been undertaken. The first step in this work consists in tabulating the distribution of each species by stations, and in plotting out these distribution areas upon suitable charts. By authorization of the commissioner, Mr. Chas. V. Morrill, of Columbia University, has been engaged to carry out this work, and a map will shortly be printed depicting the coast line of Vineyard Sound and Buzzards Bay, together with the dredging stations established therein, but lacking other details. It is intended that the distribution of each of the more important species shall be plotted upon a separate copy of this map.

Another chart, representing on a minute scale the topography of a small group of partially submerged rocks in Woods Harbor was constructed by Mr. F. W. Cushwa, under the direction of Dr. Davis. Printed copies of this chart will be employed for portraying annual and seasonal fluctuations in the distribution of various forms of marine life, particularly algæ.

III. CARD CATALOGUE RECORD OF LOCAL FAUNA AND FLORA.

Work upon this record has likewise been continued actively. During the spring of 1904 the notes hitherto abstracted from various sources were transferred in typewriting to catalogue cards, according to the system already described.* In all, 1,146 species were thus recorded, and upwards of 5,000 cards employed. The cata-

* Science, February 12, 1904.

logue, even in its present condition, has already proved its usefulness.

During the summer, Messrs. Max Morse, D. W. Davis and some of the other assistants completed, as far as was then practicable, the search for published data. The *Reports* and *Bulletins* of the U. S. Fish Commission, the *Transactions of the Connecticut Academy of Sciences,* the *Biological Bulletin,* the *American Naturalist* and the *Journal of Morphology,* together with the large collection of reprints contained in the library at the station, were systematically searched, and all relevant facts, even incidental references to the ecology of local species, were recorded. In all 84 papers were found to contain information of the sort desired, in addition to those abstracted during the preceding year.

There must also be mentioned a most valuable set of 113 cards in possession of the Marine Biological Laboratory, and kindly loaned by Dr. F. R. Lillie for incorporation into the present catalogue system. These cards record personal observations by various well-known investigators who have been connected with the Marine Biological Laboratory in past years. In addition, several zoologists generously prepared during the summer extensive sets of notes upon groups to which they had given especial attention. Mr. Lynds Jones furnished data relating to 104 species of marine and shore birds of the neighborhood; Professor Chas. B. Wilson furnished a set dealing with fifty species of parasitic copepods; Dr. W. R. Coe contributed notes relating to 32 local nemerteans and Dr. J. P. Moore prepared records of 25 species of polychæta. In addition valuable notes were received from Dr. A. L. Treadwell and Dr. Louis Murbach, dealing with polychæta and medusæ respectively.

It is needless to add that the data derived from the collecting work in progress will be incorporated as soon as they are made available.

IV. INDIVIDUAL INVESTIGATIONS.

Robert L. Baird, assistant in zoology and geology, Oberlin College, carried on experiments in the endeavor to determine the presence of sense of smell in *Fundulus,* to differentiate that sense from the sense of taste, and to ascertain the importance of the sense of smell to the fish in its life habits, especially in obtaining food.

E. N. Carter, superintendent U. S. Fisheries Station, St. Johnsbury, Vt., commenced experiments with view to testing the effect of temperature at the time of fertilization upon the subsequent development of fish eggs.

Leon J. Cole, Austin teaching fellow in zoology, Harvard University, assisted in the work of the biological survey, having supervision of the dredging operations of the *Fish Hawk* in Buzzards Bay.

Winterton C. Curtis, Ph.D., assistant professor of zoology, University of Missouri, was employed by the bureau to conduct experiments with a view to determining the life history of certain parasites of fishes. The attempt was made to find some treatment by which the 'sand shark,' *Carcharias littoralis,* could be freed of the cestode *Crossobothrium laciniatum,* which with rare exceptions infests the spiral valve of this fish. The 'oil of male fern,' commonly used as a vermifuge in veterinary and human practise, was tried and proved quite effective. In all some 56 sharks were subjected to the treatment with this drug and of these there were 38 survivors, of which 26 were without any infection, the remaining 12 being infected with *C. laciniatum* in much smaller numbers than one would expect to find in any untreated specimens. The 18 non-surviving specimens, of which some were killed because they seemed to be dying, and others were examined soon after death from the treatment, showed evidence that all of the parasites had been killed by the drug before the death of the host. The best results in expurgation came from those cases in which the dose had been repeated after an interval of several days, but as this method was not perfected until late in the summer, it was impossible to apply it to more than a limited number of specimens. Hence these results do little beyond indicating that some continuation of the experiments will be necessary in order to determine a mode of treatment effective enough for practical use in expurgating sharks for experiments in artificial infection.

Infection experiments were carried out during 1903 and 1904 to find out what cestode develops from the *Scolex polymorphus* of the 'squeteague' (*Cynoscion regalis*), when these larvæ are fed to the sand shark. Each year a number of the sharks thus infected were found to contain large number of young *Phoreibothrium triloculatum Linton,* a cestode which is recorded from the 'dusky shark' (*Carcharinus obscurus*). Some evidence was obtained pointing to the conclusion that *Scolex polymorphus* likewise comprises larvæ which develop into the genus *Crossobothrium,* but this evidence is so inconclusive that it can have no value unless strongly confirmed by the results of futher investigation.

Bradley M. Davis, Ph.D., assistant professor of botany, University of Chicago, supervised the collecting and identifying of marine algæ in connection with the dredging work, being assisted in this task by Miss L. J. MacRae. Dr. Davis likewise commenced the compilation of a set of records of the marine plants of this region to be incorporated into the catalogue of local marine fauna and flora.

Donald W. Davis, student in Harvard University, assisted in the survey work, as well as in certain experiments with fishes to be described below.

Irving A. Field, Thayer Scholar, Harvard University, continued, as salaried assistant, his studies of the food of fishes of little or no food value, adding to the list of those investigated during the preceding summer the 'horned dog-fish' (*Squalus acanthias*), and the 'sand shark' (*Carcharias littoralis*). Experiments with view to determining the food value of the common dog-fish, and to discovering other possible economic uses, were likewise continued.

Frederic P. Gorham, Ph.D., associate professor of biology, Brown University, conducted, on behalf of the bureau, (1) bacteriological studies upon an epidemic disease of the menhaden then prevalent in Narragansett Bay and in certain parts of Buzzards Bay; (2) experiments, continued from the preceding year, upon the effects of various sorts of metal piping upon marine organisms kept in aquaria; (3) studies of certain properties of the blood of various marine animals.

Clarence W. Hahn, A.M., teacher of biology, New York High School of Commerce, carried on experiments upon the regeneration of *Holocampa, Metridium* and *Sagartia,* with view to discovering the causes that determine the growth of the directive mesenteries. Time was also spent in collaborating results already obtained on this subject.

Lynds Jones, M.S., instructor in zoology, Oberlin College, continued his studies upon the food of marine birds. The living birds were closely observed in their natural habitat, their method of fishing and of feeding their young being studied. The various local nesting grounds of the terns and gulls were visited, nine days being spent on Muskeget Island. Young gulls and terns were brought back and studied in confinement for some weeks.

B. W. Kunkel, graduate student, Yale University, collected and carried on a preliminary study of the brains of eighteen species of elasmobranchs and teleosts of the locality, devoting his principal attention to the epiphysis.

Edwin Linton, Ph.D., professor of biology, Washington and Jefferson College, was engaged, on behalf of the bureau, (1) in working over a collection of entozoa from fish and fish-eating birds made by Mr. Vinal Edwards from September, 1903, to June, 1904, and contained in 300 vials; (2) in working over material collected during the current season by himself and an assistant, special attention being devoted to certain cestode parasites which were found in great numbers in the butter-fish (*Rhombus triacanthus*).

Lillian J. MacRae, teacher in South Boston High School, assisted Dr. Davis in the work of collecting and identifying marine algæ.

W. J. Moenkhaus, Ph.D., associate professor of physiology, Indiana University, repeated certain experiments of previous years in order to obtain material for further study of the behavior of chromatin in hybrids. The following crosses were made: (1) *Fundulus heteroclitus* ♀ × *Gasterosteus bispinosus* ♂, (2) *Fundulus heteroclitus* ♀ × *Stenotomus chrysops* ♂, (3) *Fundulus majalis* ♀ × *F. heteroclitus* ♂, (4) *Fundulus majalis* ♀ × *Tautogolabrus adspersus* ♂. An attempt to fertilize *Fundulus* eggs with the sperm of *Opsanus tau* was unsuccessful.

J. Percy Moore, Ph.D., instructor in zoology, University of Pennsylvania, made considerable progress with the synopsis of annelids of the Woods Hole region which he is engaged in preparing on behalf of the bureau, completing the families of Polynoidæ and Nereidæ, and drafting descriptions of species belonging to other families. The determination of the relations of the various sexual phases of the species of the latter family being a matter of considerable difficulty, the collection of suitable material for this purpose consumed much time. The life history of *Platynereis megalops* proved to be quite as complex as that of the classical *P. Dumerilii*, presenting, however, some important differences. With the exception of *Nereis arenaceodentata,* heteronereids of all the species have been found. An additional new species of *Nereis* was also discovered. The Polynoidæ and other scaly polychæta are of well-known species, though several new to the region have been found. The large felted polychæte, commonly called the 'sea mouse,' of American waters, has always been identified with the European *Aphrodite aculeata*. A careful study of specimens taken off Nantucket and Marthas Vineyard show that the species occurring there is quite distinct. The dredging operations connected with the biological survey resulted in large collections of polychæta, the determination and recording of which required much time. Besides adding several forms to the known fauna of the region, the most interesting of which is the remarkable *Spiochætopterus oculatus,* this work has added greatly to our knowledge of the local distribution of certain species.

Max Morse, fellow in zoology, Columbia University, assisted in the work of the biological survey, as well as in biometric studies carried on by Dr. Sumner.

Raymond C. Osburn, teacher of biology, New York High School of Commerce, assisted in the work of the biological survey, having supervision of the dredging operations of the *Phalarope*.

George H. Parker, Ph.D., assistant professor of zoology, Harvard University, continued, as salaried investigator, his experiments of a previous summer upon the hearing of fishes, devoting especial attention to the functions of the ear of the squeteague (*Cynoscion regalis*). The latter consists of a dorsal utriculus, with three semi-circular canals, and of ventral sacculus containing a large otolith. The cavity of the utriculus does not communicate with that of the sacculus; hence the ear of this fish, unlike that of most vertebrates, is represented anatomically by two separate parts. When the utriculi and their appended semi-circular canals and nerves were cut, the fishes showed characteristic disturbances in their equilibrium, and these disturbances persisted till death. Such fishes were as responsive as normal ones to sound vibrations produced by tapping with a mallet on the side of the wooden aquarium in which they were kept. When the otoliths, which are normally quite freely movable in the sacculi, were pressed by means of pins against the outer, non-nervous sides of their chambers and were thus fastened, the fishes showed no disturbance of equilibrium, but did not react to sound vibrations as do normal fishes. It, therefore seems probable to Dr. Parker that the utriculus and the semicircular canals are sense organs concerned with equilibrium, and that the sacculus with its contained otolith is an organ of hearing.

Henry F. Perkins, instructor in zoology, University of Vermont, and Carnegie research assistant, continued his endeavors to rear the eggs of *Gonionemus murbachii*, with view to a study of the embryology of this form. This task has proved extremely difficult in the past, but preliminary steps were successfully taken. Towing collections of various hydromedusæ were also made from the wharf, furnishing material for a study of the formation of new tentacles.

L. Charles Raiford, instructor in chemistry and dyeing, Mississippi Agricultural College, carried on studies upon the intestinal bacteria of certain fishes. Cultures were taken from 57 dog-fish and 26 menhaden, and those organisms which appeared to be of constant occurrence were isolated in pure culture. So far as his work has been carried, Mr. Raiford believes that all of the bacteria found are commonly known species.

H. W. Rand, Ph.D., instructor in zoology, Harvard University, collected and prepared material for studies of the venous system of the skate. Injections were made of the hepatic portal, cardinal and lateral veins, with a view to determining the relations and connections of these several systems of veins in the posterior region of the abdominal cavity. Dr. Rand also made a series of observations on the respiratory movements of the skate, with special reference to the functions of the spiracle.

George G. Scott, M.A., tutor in philosophy, College of the City of New York, and assistant in charge of the supply room at the laboratory, carried on studies upon the sporozoa parasitic in various marine invertebrates.

Grant Smith, Ph.D., teacher of biology, Chicago Normal School, collected and prepared material for the study of the eyes of various marine invertebrates.

W. L. Sperry, Rhodes scholar elect, carried on studies upon the muscular and nervous systems of the star-fish, *Asterias forbesi*. In this work Mr. Sperry assisted Professor H. L. Clark, who, however, was not himself present this season. Certain features of the musculature were studied in detail and drawn, observations upon the movements of the living animal were made, and experiments were made to determine suitable methods of staining.

M. X. Sullivan, Ph.D., instructor in chemical physiology, Brown University, investigated the physiology of digestion in the common dog-fish.

Francis Bertody Sumner, Ph.D., instructor in zoology, College of the City of New York, and director of the laboratory, was occupied with (1) work upon the biological survey of the marine fauna and flora of the vicinity of Woods Hole (*see above*), (2) the card catalogue record of local species (*see above*), (3) experimental and statistical studies of various fishes with reference to adaption and selection. In the experimental part of this work, Dr. Sumner was assisted by Mr. D. W. Davis, in the biometric part by Messrs. Davis, Metcalf, Morse and some other assistants.

E. E. Watson, student in Iowa University, was engaged in biometric studies of various local crabs.

Chas. B. Wilson, A.M., professor of biology, State Normal School, Westfield, Mass., carried on studies of parasitic copepods, both living and preserved material being used. Many interesting facts relating to the ecology of these parasites, some of possible economic value, were discovered. In a number of cases the life history was traced partially or completely. A considerable number of new species were found. Professor Wilson likewise prepared an extensive set of records of local parasitic copepods for incorporation into the faunal catalogue.

Commissioner G. M. Bowers, Dr. B. W. Evermann, chief of the Division of Scientific Inquiry, and Mr. E. L. Goldsborough, assistant in that division, likewise spent portions of the summer at the station; and the hospitality of the laboratory was extended to Mr. Chas. R. Knight, the well-known animal painter, and to Mr. S. F. Denton, the illustrator and taxidermist.

Francis B. Sumner.

*ALBATROSS EXPEDITION TO THE EASTERN PACIFIC.**

II.

We left Callao for Easter Island Saturday afternoon, December 3; as far as 90° west longitude we remained in the Humboldt current, as we could readily see from the character of the temperature serials and from the amount of pelagic life we obtained from both the surface and the intermediate hauls. This current also affected the bottom fauna, which was fairly rich even as far as 800 miles from the shore while we remained within the limits of the northern current. As soon as we ran outside of this the character of the surface fauna changed; it became less and less abundant as we made our way to Easter Island, the western half of the line from Callao becoming gradually barren. This current also affected the deep-sea fauna to such an extent that towards Easter Island, at a distance of 1,200 to 1,400 miles from the South American continent, our trawl hauls were absolutely barren; the bottom for the greater part of the line was covered with manganese nodules on which were found attached a few insignificant siliceous sponges, an occasional ophiuran, and a few brachiopods or diminutive worm tubes, the same bottom continuing to Sala y Gomez and between there and Easter Island. Sala y Gomez and Easter Island are connected by a ridge, on which we found 1,142 fathoms near Sala y Gomez, and 1,696 fathoms between that point and Easter Island. The ridge rises rapidly from about 2,000 fathoms, the general oceanic depth within about

* Extract from a letter of Mr. Alexander Agassiz to Hon. George M. Bowers, U. S. Fish Commissioner, dated Chatham Island, Galapagos, January 6, 1905.

100 miles, to over 1,100 fathoms within a comparatively short distance from both Sala y Gomez and Easter Island.

The southern part of our line from Easter Island to the Galapagos shows all the features characteristic of the western part of the line from Callao to Easter Island; like the latter, as far as the twelfth degree of southern latitude, it proved comparatively barren, the bottom consisting of manganese nodules to within about 250 miles of the Galapagos. The pelagic and intermediate fauna from Easter Island to 12° south latitude was very poor, and the serial temperatures show that we were outside and to the westward of the great Humboldt current. But near the twelfth degree of southern latitude a sudden change took place; the pelagic and intermediate fauna became quite abundant again, and soon fully as rich as at any time in the Humboldt current. There was also a marked change in the temperature of the water as indicated by the serials, showing that from the twelfth degree of southern latitude to the Galapagos we were cutting across the western part of the Humboldt current. The great changes of temperature which took place in the layers of the water between 50 and 300 fathoms are most striking, and show what a disturbing element the great mass of cold water flowing north must be in the equatorial regions of the Panamic district to the south and to the north of the Galapagos. South of the Galapagos the western flow of the Humboldt current must be nearly 900 miles wide, and of about the same width when running parallel to the South American coast.

The range of temperatures between 30 fathoms and 150 fathoms is at some points as great as 21°. Such extremes can not fail to affect the distribution of the pelagic fauna, and may account for the mass of dead material often collected in the intermediate tows at depths of less than 300 fathoms, when the range becomes as great as 28°. Such a range of temperature is far greater than that of the isocrymic lines which separate coast faunal divisions. The bottom fauna, as we entered the Humboldt current going north, gradually became richer in spite of its being covered with manganese nodules.

The two lines centering at Easter Island developed the Albatross Plateau indicated on the *Challenger* bathymetrical charts, on the strength of a few soundings reaching from Callao in a northwesterly direction and of a couple of soundings on the twentieth degree of latitude. The Albatross Plateau is marked as a broad ridge separating the Buchan Basin from the deep basin to the westward, of which Grey Deep and Moser Basin are the most noted areas.

Our line from Easter Island to the Galapagos showed a wonderfully level ridge, varying in depth only from 2,020 to 2,265 fathoms in a distance of nearly 2,000 miles. The soundings we made to the eastward from the Galapagos to the South American coast, and to the westward of Callao, as well as on the line from Callao to Easter Island, all indicate a gradual deepening to the eastward to form what the *Challenger* has called the Buchan Basin, with greatest depths of 2,400 to over 2,700 fathoms, and passing at several points near the coast to Milne-Edwards Deep, Haeckel Deep, Krümmel Deep and Richards Deep, some of them with a depth of over 4,000 fathoms. According to the *Challenger* soundings the Juan Fernandez Plateau connects with the Albatross Plateau and forms the southern limit separating Buchan Basin from the Barker Basin to the south of the Juan Fernandez Plateau.

At Easter Island we found our collier awaiting our arrival. We moved from Cook Bay to La Pérouse Bay to coal, as there was less swell there than in Cook Bay, where we could scarcely have gone alongside for this purpose.

Considerable shore collecting was done at Easter Island. We must have brought together at least thirty species of plants. The flora of Easter Island is very poor. There are no trees nor native bushes—not even the bushes which characterize the shore tracts of the most isolated coral reefs of the Pacific are found there; and yet some of the equatorial counter-currents must occasionally bring some flotsam to its shores. We collected a number of shore fishes and made a small collection of the littoral fauna. The fishes have a decided Pacific look, and the few species of sea-urchins we came across are species having a wide distribution in the Pacific.

While coaling, we spent some time examining the prehistoric monuments which line the shores of Easter Island. During our stay at La Pérouse Bay we visited the platforms studding the coast of the bay, and made an excursion to the crater of Rana Roraka, where are situated the great quarries from which were cut the colossal images now scattered all over the island, many of which have fallen near the platforms upon which they were erected. Near Rana Roraka, at Tongariki, is the largest platform on the island, about 450 feet in length, to the rear of which are fifteen huge images which have fallen from the pedestals upon which they once stood. The plain in the rear of the platform is crowded with stone houses, most of which are in ruins.

On our return to our anchorage at Cook Bay, we examined the platforms within easy reach of the settlement, and also the crater of Rana Kao, on the north rim of which, at Orongo, are a number of the stone houses built by the people who quarried the great stone images. At Orongo are also found sculptured rocks, but neither the sculptures nor the images show any artistic qualities, though the fitting of some of the cyclopean stones used in building the faces of the platforms indicate excellent and careful workmanship. To Mr. C. Cooper, manager of the Easter Island Company, we are indebted for assistance while visiting the points of interest of the island. He was indefatigable in his exertions in our behalf.

We took a number of photographs during our stay; illustrating not only the prehistoric remains, but giving also an idea of the desolate aspect of Easter Island during the dry season.

We arrived at Wreck Bay, Chatham Island, Galapagos, on the third of January, where we found a schooner with a supply of coal. As soon as the ship has been overhauled and coaled we shall start for Manga Reva, where we ought to arrive the last days of January. We reached Chatham Island towards the end of the dry season. Everything is dried up, the vegetation seems dead with the exception of a few small wild cotton plants, weeds, cactus and an occasional mimosa; and the great barren slopes present fully as uninviting an aspect as when Darwin described them. When the *Albatross* visited the Galapagos in March, 1891, everything was green, presenting a very marked contrast to its present desolate appearance.

Alexander Agassiz.

SCIENTIFIC BOOKS.

Problems in Astrophysics. By Agnes M. Clerke. London, Adam and Charles Black; Agents in America, The Macmillan Co. 1903. Pp. xvi + 567, with 81 illustrations. $6.00 net.

Qualified by her authorship of those excellent works 'The History of Astronomy in the Nineteenth Century' and 'The System of the Stars,' and by her obviously minute and critical study of current research in this field, Miss Clerke presents in her latest work a lucid account of pending problems in astrophysics.

Her brilliant style of writing is maintained throughout, and is sure to fascinate even the reader who does not fully comprehend her meaning. Sometimes, indeed, her lavish use of synonyms must puzzle those not familiar with the subject; but it carries her and her readers lightly and pleasantly over some chapters that would certainly be dry in the hands of most authors.

The keynote of the book is suggestiveness, as the author points out in the preface, and there could be no better tribute to her success in this respect than the use made of her work by astronomers. She clearly differentiates the known and the unknown, and emphasizes what ought to be found out.

The book can be commended to the attention of the physicist and the chemist. It is unfortunate that so few workers in the field of chemistry seem to take a positive and active interest in the problems of astrophysics; for in many respects its progress is being delayed while developments are awaited from the chemical laboratories. When these developments come, as when Ramsay solved the mystery of helium, the forward movement is rapid. Students of electricity also ought to find considerable of interest in this book and its topics, for our nearest approaches to laboratory representations of stellar phenomena seem to be of an electrical character. Yet we really do not know at all how these electrical phenomena can be brought into their proper relation to the thermal conditions which doubtless obtain in the stars.

The work before us is divided into two parts, 'Problems in Solar Physics' and 'Problems in Sidereal Physics,' the second part occupying something more than two thirds of the volume. The fourteen chapters of the first part deal with the sun's chemistry, and separately with its successive envelopes. Two chapters are devoted to sun-spots, and they sufficiently disclose our ignorance as to the nature and cause of these familiar but no less puzzling phenomena. The last three chapters treat of the solar rotation, the solar cycle and 'the sun as a whole.' The author's point of view is the safe and conservative one which has been taught by Young and by Huggins. Schmidt's refraction theory of solar phenomena is regarded as largely of academic interest. The general reader may safely accept the author's comments as well balanced; and there is no concealment, but rather a frank avowal, of the extent of our present ignorance on the problems of the sun.

Part II. includes forty-one chapters and enters into the personal details—the *vie intime*—of the stars, possibly rather too minutely for the general reader. But it is decidedly interesting reading, and the reviewer must confess that the belatedness of this review is due to the tendency to peruse these details repeatedly to the detriment of obtaining a broad survey of the book. The author adopts a rather simple scheme for classifying stellar spectra and gives to each class a chapter. Anomalous and bright-line spectra receive an ample treatment. Spectroscopic binaries and eclipsing stars also get considerable attention. 'The problem of Beta Lyræ' occupies a chapter of twenty pages, while the longest chapter is devoted to temporary stars, including Nova Persei. After clusters have been discussed, the nebulæ are taken up in nine interesting chapters, and few of the objects of this class which have been carefully studied are omitted in the author's detailed treatment. A brief final chapter discusses the physics of the Milky Way.

References to the original sources are faithfully given throughout the work, and apparently with few typographical errors, from which the book is otherwise quite free. We wish that Miss Clerke would adopt the use of the convenient word spectrogram instead of making *spectrograph* serve for both the instrument and the photographic result of its use. Slips of the pen seem to be rare, and there are few points at which a conservative reader would interpret the results of observations very differently from the author.

The thirty-one insert plates are for the most part excellent. Those printed in the text, except diagrams, are less satisfactory, notably the picture of prominence on p. 104. The light weight of the paper makes the handling of the book a pleasure—and it is likely to be handled rather frequently by many of its owners.

Edwin B. Frost.

Yerkes Observatory.

La Montagne Pelée et ses Eruptions. Par A. Lacroix. Ouvrage Publié par l'Académie des Sciences sous les Auspices des Ministères de l'Instruction publique et des Colonies, Paris. 1904. Pp. xxii + 662. 30 plates and numerous text figures.

The most complete report on Martinique yet published is that of Professor Lacroix, which embodies the results of his researches during two extended sojourns in the West Indies. Few geologists were better qualified to undertake the task and unusual facilities were offered him to make as exhaustive an examination as the conditions would permit of the volcano Pelée.

Professor Lacroix was sent, at the suggestion of the Académie des Sciences, by the Minister of the Colonies at the head of a scientific commission to study the effects of the eruption of Pelée and to examine into its causes. The commission consisted, in addition to Professor Lacroix, of M. Rollet de l'Isle and M. Giraud. After a preliminary visit of little more than a month in June and July, 1902, the party returned to France to arrange for a longer visit in the dry season. The eruption of the thirty-first of August hastened Professor Lacroix's departure and he arrived a second time at Fort de France on the first of October alone, the other members of the mission being unable to accompany him. During this second visit, which lasted nearly six months, the greater part of the material was gathered upon which the present report is based.

Two observatories were established from which the volcano could be watched day and night, and at these posts were cameras and various instruments for the purpose of recording with as minute detail as possible all events, or changes in the form of the mountain. The results of these observations were correlated by Professor Lacroix, who devoted a greater part of his own time to an examination of the volcano, the collection of specimens, and to obtaining, if one may judge from the illustrations of the book, a large number of very remarkable photographs.

In presenting his results Lacroix has arranged them under three heads: The first part, which is by far the longest, deals with the geological and physical problems involved in the eruptions, and contains detailed descriptions of the more violent outbreaks. The second part is devoted to a petrographical study of the actual products of the eruption and to a comparison of these with rocks from the other islands of the Lesser Antilles. In the third part, the various products resulting from the conflagration of Saint Pierre are discussed, particular attention being paid to the secondary minerals developed and the effect of intense heat on the old andesite of which most of the houses were built.

Much of the information contained in the first part will be familiar to those who have followed Lacroix's earlier reports and the descriptions of the American observers, but certain chapters are of unusual interest to geologists, especially those which deal with the processes involved in the formation of the famous 'dome' and 'spine,' the theory of the 'burning clouds' (nuées ardentes) of the more violent eruptions, the deposits of fragmental materials, and the various secondary phenomena. After summarizing in chapter I. of the first part the geology of Martinique and the other Antillean islands, and describing earlier eruptions, the author calls attention in chapter II. to the single center of eruption and the absence of secondary vents. A study of the modifications in topography resulting directly from the great eruptions shows them to have been relatively slight, from a geological point of view, when compared with the devastation wrought. Judging from the records of cable repair ships no marked changes in submarine topography occurred and the breaking of the cables is attributed to the shelving of deltas at the mouths of streams descending from the flanks of Pelée.

In chapter III. Lacroix describes the evolution of the 'dome' and offers an explanation of the processes involved in its development. Briefly, the 'dome' is the eminence which has appeared within the old crater (Etang Sec) since the eruption of May 8, 1902, and which was considered by some of the American observers as merely a secondary cinder cone, or an accumulation of fragmental ejected material about the actual vent. Lacroix denies that it is of fragmental nature and states that it is, in fact, a homogeneous mass of viscous lava surrounded by an envelope of the same substance cooled and consolidated. The explanation of this phenomenon and of the remarkable spine of solid rock which has from time to time risen above the dome itself is essentially as follows:

The viscous magma on reaching the surface through the throat of the volcano and forming a protuberant mass is quickly surrounded by a solid shell or envelope which protects the still pasty interior from a too rapid cooling. This envelope becomes fissured, under the influence of progressive solidification, and the increase in volume of the mass itself, and through the clefts thus formed fresh molten material is exuded. In this way a homogeneous rocky mass increases in height and volume, bristling with jagged points, glowing like a 'charcoal-burner's fire' at night, and bounded by abrupt walls which rise from the debris accumulating at its base from incessant superficial crumbling. Projected materials resulting from violent eruptions play but a small part in the constitution of such a dome. A dome so constructed is not characterized by any permanent vent or crater, but violent eruptions determine such openings, which are of a temporary nature and rapidly closed. When the envelope has become sufficiently resistant to permit no longer a growth in all directions, the action of the pressure is localized at certain points and results in the extrusion of solid rocky masses issuing as from a mold and producing needles or spines which may attain an elevation of several hundred meters. In the course of a single eruption the point at which the pressure concentrates itself may be displaced, and successive spines may result of diverse forms, dimensions and positions, and often of an ephemeral existence, for continual crumbling tends to modify or totally destroy them. This process, which has been unrecognized up to the present, and which Lacroix is the first to describe, explains, in his opinion, the origin of the many peculiarities of structure of 'domes' in volcanic regions where activity no longer is manifest, and which have often been assumed to be the cores of dissected volcanoes.

Four types of rock were recognized as constituting the dome and spine, the specimens being collected from the talus extending down the Rivière Blanche from the base of the dome, and from the edge of the old crater after violent eruptions. The four types are differentiated by the character of their groundmasses, the phenocrysts being the same; they are essentially hypersthene andesites. Rocks of the first two types are glassy, the first being obsidian, the ground-mass of the second containing a few microlites of an acid plagioclase in a glassy base. The third type is a porous or vesicular andesite containing greater or less amounts of plagioclase microlites in the ground-mass; the fourth type differs but little from the third except that the groundmass contains quartz in small crystals frequently abundant enough to make the rock microgranular. Of these four types I. and II. are believed to have been derived from the shell or envelope of the dome, type I. probably representing the original crust, and type II. the material filling the cracks and fissures in the outer shell. Rocks of these types are abundant in the ejectamenta of violent eruptions. Specimens of types III. and IV. were obtained from the quiet crumbling or breaking down of the spine. The quartz-rich rocks are assumed to have come from the interior of the spine and are the result of a much slower cooling of the magma, while rocks of type III. represent a somewhat more rapid cooling. In commenting upon these quartzose andesites, Lacroix says: "* * * The actual production of quartz-bearing rocks, more or less completely microgranular, which I consider one of the most important observations that I had occasion to make, shows that the conditions necessary for the formation of quartz in a volcanic rock may be realized at slight depth under the solidified outer shell of a dome of acid rock in process of evolution" (page 157).

In part II., on petrography, this matter is taken up in greater detail and the conditions controlling the crystallization of quartz discussed. The microlites of feldspar and the metasilicates like the phenocrysts are essentially the products of igneous fusion, but the quartz is assumed to have crystallized under hydrothermal conditions acting at a lower temperature. These opinions are especially significant, coming as they do from one of the foremost French petrographers.

Chapter IV. deals with the most evident and apparent expressions of vulcanism—the great clouds of vapor ladened with fragmental material, the 'burning clouds' (nuées ardentes) which swept down the flanks of Pelée and annihilated Saint Pierre, mud-flows, etc. Several chapters follow in which the different violent eruptions are described and the theory of the 'burning clouds' is discussed. Chapter IX. is an important one on the character and distribution of the fragmental deposits and their subsequent erosion. The first part closes with an account of the various accessory phenomena, as atmospheric electricity, changes in atmospheric pressure, abnormal optical phenomena, etc.

Part II. consists of a systematic petrographical study of the recently erupted rocks in which, it is interesting to note, the author makes frequent use of the Quantitative System recently proposed by Cross, Iddings, Pirsson and Washington, finding it most convenient for purposes of comparison. The mineral composition and texture of the rocks are described, and the conditions already mentioned, which have influenced the consolidation of the magma, are discussed in detail. The older rocks of Martinique and a number from other islands of the Lesser Antilles are compared, and a consideration of their chemical composition leads to the recognition of a well-marked petrographic province.

In part III. Lacroix presents the results of his observations on the products resulting from the burning of Saint Pierre. The effect of intense heat on metals, glass, structural stone-work, etc., was often sufficient to cause complete fusion, leading to the formation of a considerable variety of secondary minerals.

The book bears evidence in places of hasty preparation and there is considerable needless repetition, but, on the whole, it must be recognized as the most complete and masterly presentation that has yet appeared of the facts and problems related to the West Indian eruptions of 1902–3. The promptness with which the final report was published after the close of the field work deserves praise in itself, and too much can not be said of the excellence of the numerous illustrations which, with very few exceptions, are from untouched photographs and are faithful records of the events from soon after the disaster of May 8, 1902, until the autumn of 1904.

Ernest Howe.

Washington, D. C.,
March 22, 1905.

SCIENTIFIC JOURNALS AND ARTICLES.

The February number (volume 11, number 5) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the Eleventh Annual Meeting of the American Mathematical Society, by F. N. Cole; 'Mathematical Progress in America' (Presidential Address), by T. S. Fiske; Report of the Sectional Meetings of the Heidelberg Congress (Continuation), by E. B. Wilson; Report of the Breslau Meeting of the Deutsche Mathematiker-Vereinigung, by R. E. Wilson; 'The Construction of Conics under Given Conditions,' by M. W. Haskell; Notes; New Publications.

The March number of the *Bulletin* contains the following articles: 'The Present Problems of Geometry,' by Edward Kasner; Report of the Fifty-fourth Annual Meeting of the American Association for the Advancement of Science, by L. G. Weld; 'A Calculus for Geometers' (Review of Humbert's Cours d'Analyse), by E. R. Hedrick; 'Halsted's Rational Geometry' (Review), by S. C. Davisson; 'Tchebychef's Theory of Congruences,' by André Markoff; Notes; New Publications.

The American Naturalist for February opens with an article by J. S. Kingsley, on 'The Bones of the Reptilian Lower Jaw,' showing the presence of an element, the dermarticulare, which sometimes remains distinct, but more often fuses with the articulare. Other articles are 'Natural and Artificial Parthenogenesis,' by Alexander Petrunkevitch; 'The Angle of Deviation from the Normal Vertical Position at which Stems show the Strongest Geotropic Response,' by Julia A. Haynes (a difficult title for the cataloguer), and 'Note on the Variation in the Bay Flowers of Rudbeckia,' by Raymond Pearl.

The Popular Science Monthly for April contains a most important article, 'The Menace to Niagara,' by John M. Clarke, showing the entire probability that the American Falls will be destroyed if present plans are carried out. Other articles are 'Sunspots and Weather,' by Ernest W. Brown; 'Medical Research, its Place in the University Medical School,' by Theobald Smith; 'The Problem of Immigration,' by Allan McLaughlin; 'Age and Eminence,' by Edwin G. Smith; 'Authority in English Pronunciation,' by Edwin W. Bowen, which shows the part dictionaries play in fixing the pronunciation of words, and, finally, 'The Bermuda Islands and the Bermuda Biological Station for Research,' by Edward L. Mark. In correspondence Olivia R. Fernow discusses the question 'Does Higher Education Unfit Women for Motherhood' in reply to the somewhat hysterical article by Dr. Smith in March. The number completes Volume LXVI. and has the index.

SOCIETIES AND ACADEMIES.

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

The regular meeting of the section was held on Monday evening, January 8, at Fayerweather Hall, Columbia University.

The following papers were presented:

Experiments Relating to the Conductivity of Powders at High Temperatures: Herschel C. Parker.

When a conducting powder like graphite is mixed with a non-conducting refractory powder, the resistance increases quite rapidly at first; as the proportion of graphite is decreased, then more slowly, and after a time reaches a critical point where there is no conduction or the graphite is destroyed by arcing.

When the percentage of the conducting powder is low a mechanical separation or 'striation' takes place on packing in the refractory tubes. Besides this an electrolytic separation usually takes place after a time and the conductivity of the mixture is destroyed by arcing.

A very great variety of substances and mixtures were experimented with in the search for a permanent compound of high resistance.

The Magnetic Susceptibility of Water: A. P. Wills.

Experiments were made with the large electro magnet of Columbia University to determine the magnetic susceptibility of water. With the aid of this magnet, which is one of the largest in existence, Dr. Wills found the coefficient of susceptibility of water to be -0.72×10^{-6}, and also to be independent of the field strength over a range from 4,000 to 16,000 C.G.S. units.

C. C. Trowbridge,
Secretary.

SECTION OF BIOLOGY.

At the March meeting papers were presented by Mr. L. I. Dublin, of the College of the City of New York; Mr. Frederic A. Lucas, director of the Brooklyn Museum; and Professor F. S. Lee, of Columbia University.

Mr. Dublin described the history of the germ-cells in *Pedicellina americana,* giving special attention to the chromatic changes. The somatic number of chromosomes is twenty-two. These bodies behave, throughout, very much as has been described by many workers on other forms; but in addition there has been observed a peculiar process in connection with the reduction of the chromosomes. These are V-shaped in the somatic cells and in the several generations of oogonia and spermatogonia, with the exception of what appears to be the last. In this the number is still twenty-two, but they are bar-shaped. These divide and, either before or at the telophase, apparently unite end to end in pairs to form eleven new V's, each bivalent as compared with the earlier structures. A longitudinal splitting of these loops, coincident with the extensive growth of the individuals, produces in the first maturation division eleven ring- or bar-shaped chromosomes each of which is structurally a tetrad. The first division is thus reducing; the second, equational. The change in chromosome form in the last oogonial and spermatogonial generations is then clearly a striking adaptation to the subsequent synapsis or reduction, making the latter easily possible.

Mr. Lucas gave an account of whales and whaling on the coast of Newfoundland, illustrating his remarks with stereopticon views of the whales and stages of their capture. Three species of whales were described, the finback, the humpback and the sulphur-bottom, the first two being found on the south and east coast, the last one on the south coast only. The speaker then described the past and present methods of capture and utilization, saying that whales are now worked up so rapidly that within forty-eight hours after one is brought to the whaling station, it is reduced to oil, fertilizer and bone. The lecture closed with an interesting account of the method employed in making the mold of the large model of a whale shown by the National Museum in the exhibit at St. Louis. This was possibly the largest mold ever made, and the cast was the first accurate representation of a fully grown whale.

Professor Lee discussed 'Temperature and Muscle Fatigue.' He and others have previously pointed out that the contraction process of the muscles of cold-blooded animals in the course of fatigue becomes greatly slowed, while those of warm-blooded animals show no such phenomenon. Lohmann has recently claimed that a cold-blooded muscle on being heated to mammalian temperature shows a course of fatigue similar to that of mammalian muscle; and, on the other hand, that a warm-blooded muscle on being cooled fatigues like the muscles of cold-blooded animals at a similar temperature. From these supposed effects he infers that in the matter of fatigue there is no real physiological difference between the two groups of muscle. Professor Lee has not been able to confirm Lohmann's conclusions. Every variety of muscle which has been tested, whether of cold-blooded or warm-blooded animals, shows its characteristic method of fatigue, whatever the temperature may be. The original conclusion regarding the difference between the two groups of muscles seems, therefore, to be justified.

M. A. Bigelow,
Secretary.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

The tenth regular (second annual) meeting of the Society for Experimental Biology and Medicine was held in the Rockefeller Institute for Medical Research, on Wednesday, February 15. The president, Dr. S. J. Meltzer, was in the chair.

Members Present.—Atkinson, Auer, Burton-Opitz, Dunham, Ewing, Flexner, Gies, Jackson, Lee, Levene, Levin, Mandel, Meltzer, Noguchi, Norris, Oertel, Opie, Park, Richards, Sweet, Wadsworth, Wallace, Wolf, Yatsu.

Members Elected.—George W. Crile, Haven Emerson, Cyrus W. Field, Hideyo Noguchi, H. C. Sherman, J. Edwin Sweet, Victor C. Vaughan.

Officers Elected.—President: Edmund B. Wilson; *Vice-President:* Edward K. Dunham; *Librarian:* Graham Lusk; *Treasurer:* Gary N. Calkins; *Secretary:* William J. Gies.

*Abstracts of Reports of Original Investigations.**.

Degrees of Susceptibility to Diphtheria Toxin Among Guinea-pigs. Transmission from Parents to Offspring: Theobald Smith. (Presented by William H. Park.)

Dr. Smith called attention to the usefulness of the antitoxin unit, furnished by the Institute for Experimental Therapy under the direction of Professor Ehrlich, in the routine testing of the strength of diphtheria antitoxin. The one uncertain element is the relative re-

* The abstracts presented in this account of the proceedings have been greatly condensed from abstracts given to the secretary by the authors themselves. The latter abstracts of the reports may be found in current issues of *American Medicine* and *Medical News.*

sistance of the guinea pigs to diphtheria toxin. Irregularities in the routine tests during the past year led the author to look up the genealogy of the pigs used, and he found that the different degrees of resistance belonged to certain families or litters, and were constant for those families. Thus one mother gave birth to young which did not react to what was the usual fatal dose. Four successive litters possessed the same resistance. It appeared probable that this family could stand 40 per cent. more toxin, when mixed with the antitoxic unit, than those of average susceptibility.

It would seem from these and similar observations that different degrees of susceptibility to toxin are to be found among guinea pigs and that the special degree possessed by any one is not to be attributed to individual variation, but to a family trait or character. Experiments are now under way to determine the part played by the male in the transmission of toxin-resistance.

The Protective Action of Venom upon Blood Corpuscles, with demonstrations: Hideyo Noguchi. (Presented by Simon Flexner.)

That concentrated solutions of venom fail to destroy and tend to preserve blood corpuscles was noted by Mitchell and Stewart. The conclusion which has been reached by the author is that venom unites with the globulins, and especially with the hemoglobin, of the red corpuscles, yielding a water-insoluble compound to which the protection is due. Various substances, but only salts, acids and alkalies, restore the hemolyzability of the corpuscles by dissolving the venom-hemoglobin compound. The permeability of the corpuscles is not markedly altered.

The Results of Attempts to Cultivate Trypanosomes from Frogs: Joseph Lewis and Herbert U. Williams. (Presented by Augustus B. Wadsworth.)

Examinations of the blood of various lower animals were made at Buffalo, N. Y., in search of parasitic protozoa. The results were negative in dogs, cats, rabbits, guinea-pigs, English sparrows, toads and mud-puppies (*Necturus maculatus*). In frogs from the Niagara River hematozoa were found quite frequently, viz., *Trypanosoma, Drepanidium* and in one case *Filaria. Trypanosoma* was seen only in midsummer.

Attempts were made to cultivate *Trypanosoma* and *Drepanidium,* using a modification of the blood-agar medium, proposed by Novy and MacNeal. Trypanosomes from the frog may be cultivated on blood-agar, but, in the experience of the writers, with considerable difficulty.

From a frog infected with *Tr. rotatorium* a flagellate organism was cultivated, showing important points of difference from *Tr. rotatorium.* It is possible that, owing to the technical difficulties of the experiment, some other organism may have found its way into the tubes. This is improbable.

Undoubted trypanosomes developed in blood-agar prepared from a frog whose blood, during life, showed no trypanosomes, so that they must have been present in very small numbers or in some unrecognized form. They resembled *Tr. rotatorium,* but were usually much smaller. As this blood-culture-medium was inoculated with blood from another source containing *Drepanidium,* it nearly led to the conclusion that *Trypanosoma* might develop from *Drepanidium.* We have here an illustration of the ease with which mistakes may occur in the cultivation of hematozoa which are suspected of passing through cycles. Such a possibility had been pointed out in advance by Novy and MacNeal before this society (October, 1904).

There was no evidence from the experiments to show that development of *Drepanidium* can occur in blood-agar.

Experimental Measles: Ludwig Hektoen. (Presented by Eugene L. Opie.)

The results of two experiments on adult men permit the conclusion that the virus of measles is present in the blood of patients with typical measles some time at least during the first thirty hours of the eruption; furthermore that the virus retains its virulence for at least twenty-four hours when such blood is inoculated into ascites-broth and kept at 37° C. This demonstration shows that it is not difficult to obtain the virus of measles unmixed with other microbes and in such form that it may be studied by various methods.

The Formation of the Centrosome in Enucleated Egg-fragments: NAOHIDÉ YATSU.

To test whether the centrosome is a permanent cell-organ or not, Wilson (1901) treated, with a salt solution, enucleated egg-fragments (sea-urchin) obtained by shaking. He observed that asters containing centrioles and capable of division were produced in this way in the enucleated fragments. At Wilson's suggestion the author tried the experiment in a somewhat different manner. Eggs of *Cerebratulus* were used. Individual eggs were cut into *nucleated* (*i. e.*, containing the first maturation mitotic figure) and *enucleated* fragments. The latter were kept for an hour in a solution of calcium chlorid. Then they were transferred to sterilized sea-water. Asters were produced in almost all enucleated fragments thus treated. All the asters had centrioles which were identical with those found in the whole eggs subjected to the same treatment. The nucleated half was stained and was shown to have had two original centrosomes intact. From the results of these experiments no other conclusion can be drawn than that the centrosome, with centriole, of the enucleated fragment was in each case formed *de novo*—a complete confirmation of Wilson's original deduction.

In these experiments strict precautions were taken to prevent accidental fertilization.

Structure of Vaccine Bodies in Isolated Cells, with demonstrations: JAMES EWING.

In Klatsch preparations of corneal vaccine ulcers stained by Nocht's method, the vaccine body is seen to be a portion of the cytoreticulum, its reticular structure being continuous on the one hand with the cytoreticulum and on the other usually with the nuclear reticulum. The clear zone surrounding the vaccine body in sections of tissue is an artifact. The reticulum of the vaccine body takes the chromatin stain, indicating that it contains chromatin, and many of the bodies are so intimately connected with the nucleus, the meshes of one passing insensibly into the other, as to force the conclusion that these particular bodies have arisen by recent extrusion of nuclear chromatin into the cytoreticulum. Other bodies are disconnected from the nucleus and these may have arisen partly from the chromatin of the cytoplasm, a possibility which is furnished by Hertwig's theory of the constitution of cell protoplasm. Many of the vaccine bodies closely resemble the chromidial substance described by Hertwig in some lower animal cells. In the meshes of the reticulum the author has been unable to demonstrate any organized structure, but the meshes sometimes present nodal points of an underlying reticulum. In the fresh condition the meshes contain homogeneous refractive globules which disappear on drying.

Two series of changes may be followed in the vaccine bodies in Klatsch preparations. Many of them develop basic staining areas with loss of the central reticulum, and this process may continue until the entire body is transformed into a homogeneous globule resembling mucus or colloid. In others the reticulum breaks up into granules with or without the development of a central basic mass.

The author has been unable at any stage or in any derivative of the vaccine body to detect the slightest definite trace of a protozoon. Besides vaccine bodies there are other structures resembling protozoa to be seen in Klatsch preparations. They appear to be peculiar cell granules and are present in normal animals.

On the Tetanic Element in Bile: S. J. MELTZER and WILLIAM SALANT.

The authors have shown that the injection of bile can produce tetanus as well as coma. The latter is the more constant symptom. By the use of subminimum doses of strychnin a tetanic element could be shown to occur in bile that infallibly produced coma. A frog of medium size will not respond, even with the slightest hyperesthesia, to an injection of one hundredth of a milligram of strychnin. When such a small dose, however, is injected into a frog which had received a certain quantity of bile, the animal reacts, sooner or later, with a distinct tetanus. The effective dose of bile varies with the animal from which it is obtained. The bile of rabbits produced, in many instances, distinctly convulsive effects even without the addition of strychnin.

The toxic effect on frogs of bile from normal rabbits varied considerably. The effect of the bile from some of the rabbits was predominantly coma, and from others tetanus. Heating the bile seemed to reduce the stupefying, paralyzing effect and to favor the appearance of the tetanic element. In the bile of nephrectomized rabbits the tetanic element was distinctly more pronounced than in the bile of normal animals.

A Preliminary Communication on the Pharmacology of Thorium: E. D. Brown and Torald Sollmann. (Presented by William J. Gies.)

Thorium nitrate precipitates proteids and is intensely astringent. Intravenous injection is promptly fatal by embolism. Applied subcutaneously, necrosis results. Introduced per os large doses have no appreciable effect. Solutions in sodium citrate are non-precipitant and non-astringent. Subcutaneous injection of large doses in citrate solution was without acute effect, although the animals appeared to be depressed and became emaciated, their tissues, after several weeks, showing widespread calcification. Absorbed thorium is excreted by the kidneys. The metal is neither absorbed nor excreted through the intestine.

A Preliminary Study of the Toxicological Action of Thorium: Arthur F. Chace and William J. Gies.

In addition to various results in harmony with those in the preceding report the authors presented the following data: In medium sized frogs at least 40 milligrams of thorium chlorid were required per os to produce the first sign of toxic symptoms, although 40 milligrams introduced subcutaneously or per rectum quickly manifested marked toxicity. Introduction per os caused irritation of the throat, increased gastric secretion, ejection of gastric contents and increased peristalsis. In fatal poisoning, by whatever channel of introduction, death was preceded by anhydrosis, twitching and progressive weakening of the muscles, with paralysis of the fore legs preceding that of the hind legs.

In warm-blooded animals large doses per os caused vomiting. In fatal cases, after introduction by other channels, death was preceded by restlessness, twitching and progressive paralysis of the muscles, labored breathing, stupor. Paralysis of the fore limbs resulted before loss of power in the hind ones.

The most constant and pronounced general effect in all the experiments was a progressive weakening of the voluntary muscles.

William J. Gies,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 164th meeting was held on February 22, 1905. The regular program included a paper by T. W. Stanton, the discussion of which was participated in by Messrs. W. H. Dall, E. O. Ulrich, David White and H. S. Williams.

The Time Element in Stratigraphy and Correlation: Mr. T. W. Stanton.

Recently published discussions concerning recurrent and shifting faunas and transgressing formations have called renewed attention to the character of the facts on which geological correlation is based and have emphasized the doubts as to the possibility of determining that widely separated deposits were or were not contemporaneous. The argument briefly stated is as follows:

If a fauna or a flora appears suddenly in a certain bed of a local section the only reasonable inference is that it must have developed in some other area where its presence is recorded in older deposits. Similarly, if a fauna suddenly disappears from a section it is more probable that a change in local condition has caused it to shift to some favorable locality where it continued to live until its elements were modified, than that it actually ceased to exist. That such shiftings of faunas have taken place is proved by the observed recurrence of closely related faunas in several stages of some local section, while the intermediate stages show different faunas. Admitting that there has been much local differentiation and shifting of faunas in the past, similarity of fossil contents alone can not be taken as proof of the exact contemporaneity of two beds, and dissimilarity of fossils within certain limits is not proof of difference in age.

When a littoral deposit is formed along the margin of a transgressing sea its base at one locality will not be synchronous with its base at another locality 100 miles farther inland. The difference in date will be measured by the time required for the sea to travel 100 miles across a subsiding area. In such cases physical continuity of a formation is not proof of exact contemporaneity.

The facts are not questioned and the importance of considering them in correlation and time determinations is obvious, but it is equally important to interpret them correctly and not to exaggerate their quantitative value. If undue importance is given to the theoretical errors in time determination and correlation caused by shifting faunas and transgressing formations, there is danger of overlooking the determinations that can actually be made or of exciting unnecessary doubts concerning them. These errors as a rule are geologically trivial and scarcely measurable in terms of the large units that must be used. The degree of accuracy that is required in human history is not to be expected in geologic history in which the time unit is so large and the scale so coarse that an interval of a few centuries is often not appreciable. The accuracy of geologic correlation, so far as the idea of contemporaneity is concerned, is commensurate only with the nature of the rough scale that must be used, and varies with the completeness and the character of the evidence in each special case. In general, the farther a correlation is carried the broader must be the terms in which it is expressed, but horizons vary greatly in this respect. At irregular intervals throughout the geologic column there are limited zones characterized by species or groups of species that have almost world-wide distribution. These zones, as Professor J. P. Smith has well stated, record times of readjustment of faunal provinces when for some reason interregional migrations were made easy. They may, therefore, be treated as geologically contemporaneous wherever they are found and they serve as the solid frame-work of the general chronologic structure.

Barriers, migrating faunas and shifting shores, make the local problems of correlation more difficult in special cases. With insufficient data or insufficient experience, or both, the geologist will make many mistakes, but when all the obtainable facts are fully studied from the broadest geological standpoint, when every element of the fauna and flora is given due weight, and when this is tested and supplemented by all other available classes of evidence, he can not only make correlations, but he can determine contemporaneity within the limits of accuracy that the subject demands.

Dr. Wm. H. Dall spoke on the evidences afforded by recent faunas, as bearing on the notion of contemporaneity in fossil horizons, drawing attention to the differences in number of species contained in a fauna relatively to its latitude, varying from 180 at Greenland, to 818 in the equatorial regions, a subject fully discussed in the U. S. Geological Survey Bulletin No. 84; to the total, or nearly total, differences between the faunas of rocky, sandy and muddy shores, due not only to the different lithologic situs, but to the differences of food-supply each afforded; to the fact that to define a fauna in the paleontologic or biologic sense, our definition must be wide enough to include all these purely local variations, and represent the whole population of a coast with all its variation of conditions; to the rapid spread of prepotent species given acceptable conditions, as in the case of *Mya arenaria*, introduced on the Pacific coast, and *Litorina litorea* on the Atlantic coast of the United States, both of which are known to have extended in profuse numbers over hundreds of miles of coast where they were previously unknown, in the course of a few years.

Dr. Dall also stated that the confusion of ideas with consequent controversies which have frequently occurred in connection with these questions, are largely due to the attempts on the part of geologists to combine in one expression two irrelevant factors, the 'formation,' considered as a lithologic unit, and the fauna as a time scale. A reference to the existing coasts is all that is necessary to prove how absurd is the idea that the 'formation' of a given area has any necessary connection with the horizon or time-place in the geological column indicated by a given fauna. The two categories are, in a broad sense, incompatible, one indicating merely local physical and dynamic conditions, and the other the stage of evolution of the organic assembly inhabiting an area probably with entirely different boundaries.

Mr. E. O. Ulrich expressed his belief that the idea that faunas required a long time to migrate from place to place is an unjustifiable assumption. The migration of the Paleozoic faunas, which included mostly shallow water organisms, was limited to zones adjacent to the shore line. The Paleozoic continent had much less relief than the present surface and the adjacent water basins were shallow, thus favoring rapid migration. With slight relief a small amount of tilting would cause rapid submergence of large areas with immediate migration of marine life. Therefore, it would result that like fossil faunas indicate at least essential contemporaneity. The case cited as illustrating such geologic conditions with the rapid spread of a fauna was that afforded by the western and southern formations of the Richmond group in the uppermost Ordovician.

Mr. Ulrich stated that his working hypothesis is that one slowly modifying fauna existed continuously on the outer border of the continent while another occupied, on the whole, much shallower and frequently changing basins upon the surface of the continent. On account of the comparatively unstable conditions prevailing there the epicontinental fauna was subjected to many vicissitudes not shared by the outer fauna. Hence considerable and often very great modifications of its character, both local and widespread, took place much more frequently than in the outer fauna. When conditions were favorable, faunas of the inner basins were, in some cases, replenished, or in others, perhaps only slightly modified by accessions from the outer faunas.

Special emphasis was put by David White, the next speaker, on the relative insignificance of the time, as measured by sedimentation, required by those faunal migrations which are not marked by changes in the composition of the fauna and recognizable mutations of the species. The interval between the two great Pleistocene ice invasions was ample for the migration of the flora and even the formation of peats in the thin deposits of interglacial clays. Between the retreat of the last ice sheet and the restoration of the faunal and floral equilibrium, as we now find it, the interval, as measured in sediments, is geologically not macroscopic. The practical contemporaneity, in the geological sense, of an identical fauna in the various parts of its distributional province is shown by the general agreement and harmony in these parts between the marine invertebrates and the other contemporaneously characteristic classes of organisms, including marine vertebrates, land plants and land vertebrates, whose directions and routes of distribution varied widely. A plea was added for a closer study and a more scrutinous characterization of species, taking into account not only the contemporaneous variation of the organism, but also especially the variations or mutations occurring within the duration of the specific type, some of these mutations being of the most restricted vertical range, and consequently of greatest stratigraphic value.

George Otis Smith,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE WESTERN SIERRA MADRE MOUNTAINS.

To the Editor of Science: The geographical and geological expedition organized by Col. W. C. Greene for the study of the western Sierra Madre Mountains of Mexico has accomplished half of the journey proposed. The party, consisting of Professor Robert T. Hill, Messrs. John Seward and F. H. Fayant and the writer, which left New York February 4, was delayed on its journey to El Paso by blizzards in Canada and the central states and exceptional cold weather in Texas. News of heavy snowfall in the mountains caused farther delay in El Paso, which was utilized by the party for a run across the arid region along the Mexican boundary as far as Naco, Arizona, and thence to Cananea, Soñora. The route followed, that of the El Paso and Southwestern Railway, is particularly instructive as giving an excellent section of the mesa and the terraces bordering the Rio Grande. One is strongly impressed with the evidence of disintegration of rocks due to the great diurnal changes of the temperature, the work of wind and of sheet-flood erosion, the production of 'calichi' or local tufaceous limestone by capillary concentration of carbonate of lime, and other phenomena too numerous to mention. The railroad traverses several 'bolsens' or pocket deserts and the accompanying volcanic cones and basaltic flows. The Chiracahua Mountains of Arizona are the northern extension of the western Sierra Madres. The bolsens contain underground watercourses, and this important fact has led the Phelps-Dodge Company to establish the town of Douglas beside the Mexican boundary in a large bolsen lying east of their copper mines at Bisbee. Comparatively shallow wells supply abundant water for the great smelters of the Phelps-Dodge and Calumet-Arizona copper companies. The Phelps-Dodge Company gave our party the courtesy of a special train for the purpose of studying and photographing the phenomena of the mesa for thirty miles along the El Paso and Southwestern Railway.

On Tuesday, February 14, the party left El Paso and went southwestward into Chihuahua over the Rio Grande, Sierra Madre and Pacific Railway to the present terminus of the road at Nuevas Casas Grandes. Fifteen miles from El Paso the road reaches the top of the mesa, and from there onward excellent studies were made and photographs taken of the vast llanos, the peculiar moving sand hills known as 'los Medanos,' the lost mountains, and the remarkable shallow lagunas, or periodical lakes, without outlet, which receive the drainage from the Sierra Madre summits and form the final settling pans for the wind- and water-driven débris from the disintegrating mountains. From Lake Guzman, the largest of these lagunas, our route ascended the San Miguel River, first through wide basin-like valleys, then through deep, rugged, tortuous cañons, until finally its head waters were reached on the undulating plains of the great Sierra Madre plateau more than 7,000 feet above the sea, and 3,000 feet above the arid plateau containing Lake Guzman.

At Casas Grandes our party was shown the great prehistoric ruins which gave the town its name, by F. Mateus, the jéfe politico of the district, and at Colonia Juarez we were hospitably entertained by Mr. Ivins, the president of the prosperous colony of American Mormons located there. At San Diego we were guests at one of the great haciendas of Gen. Luis Terrazas, governor of the state of Chihuahua. For three days we traversed land belonging to the same proprietor and were brought into close realization of the tremendous influence of the hacienda, or estate owners, upon sociological conditions in Mexico. For 300 miles eastward to the Conchas River nearly every square mile of land is the property of Governor Terrazas, and he is probably one of the greatest individual landholders in the world.

From the terminus of the railway at Nuevas Casas Grandes southward the journey has been made on horseback and with pack train, and the route thus far covered aggregates 160 miles. Most valuable studies have been made of the remarkable igneous phenomena observed *en route;* a collection of the rocks has been made for the American Museum of Natural History, and photographs have been made illustrating every phase of the physiography, geology and vegetation of the region traversed.

After leaving the impressive cañon of the San Miguel our journey lay across the high plateau for about fifty miles to the new town of Dedrick, consisting of one habitable log house and several others in process of construction in the midst of the great forest of long-leafed yellow pine which characterizes the plateaus and peaks from 7,000 to 8,000 feet in elevation. Immediately west of Dedrick the plateau is scored by the great cañon, ten miles wide and nearly a mile deep, of the Yaqui River, here known as the Aros. This streamway is one of the most stupendous scenic features imaginable, and in beauty and grandeur rivals the famous Grand Cañon of the Colorado. Guaynopita is a little mining camp on the mountainside, four hundred feet above the river and about thirty-five miles by trail west of Dedrick. The journey hither across and through the cañon has revealed a remarkable physiographic and geologic story which the party considers well worth the hardships of the journey and which will be made the subject of special papers. The region is full of archeological interest, too, through the ruins of cliff dwellers and other prehistoric peoples. In the Rio Chico branch of this cañon there is a set embracing thirty-seven houses.

From Guaynopita our course lies southward through the complex of cañons tributary to the great cañon of the Yaqui and out on to the plateau as far as Ocampo, where the famous ancient mine of Jesus Maria is located. Thence we turn back to Miñaca and there begin the long railway journey to New York.

Edmund Otis Hovey.

THE METRIC SYSTEM AGAIN.

To the Editor of Science: For the benefit of those who are clamoring for the adoption of the metric system, I desire to give an illustration of the beautiful simplicity of the system of units in vogue in the United States and Great Britain. Any of our units of measurement would answer the purpose, for they all partake of the same delightful elasticity of value. Let us take the collection of units of measure commonly denominated the gallon. In order that we may comprehend the relation of these various units to each other it is desirable to have some fixed unit as a means of comparison. As the cubic inch in use in America is not the same as that of Great Britain, and as it is desirable to use some unit of capacity that has only one value, we shall be compelled, much against our wishes, to use the liter as a unit in which to express the volume of the various members of the gallon family.

Gallon No. 1.—3.78543 liters. This gallon is variously denominated in the literature of metrology as the liquid (metric), liquid (national), metric (U. S.), Winchester, wine, and dry (metric). It is said to contain 231 American cubic inches. It is stated also that this gallon is generally used by American hydraulic engineers. It is a little difficult to be certain on this point, however, for many authors fail to state the volume of the gallon they use, in liters, and do not state whether American or British inches are meant.

Gallon No. 2.—4.4070 liters. This is the dry (national), or dry (U. S., or Br.), according to the Standard Dictionary. It is supposed to be used a good deal by tradesmen, and is sometimes referred to as a half peck. Whether it is used in England is a little difficult to ascertain, because of failure of writers to mention its volume in any fixed unit.

Gallon No. 3.—4.54346 liters. British (Mendenhall), liquid (U. S., or Br.), or Imperial gallon.

Gallon No. 4.—4.6209 liters. Legal standard dry gallon in Wisconsin and Connecticut; legal standard for ale, beer and milk in New Hampshire and Minnesota. Used in these states by tradesmen in *buying* these commodities. Also a legal standard in Maine.

Gallon No. 5.—'Proof' gallon. "This has the volume of a wine gallon containing one half its volume of nearly pure alcohol at 60° F." The number of proof gallons in a quantity of distilled liquor is found by multiplying the per cent. of proof (= twice the per cent. of alcohol present) by the number of wine gallons. Used by gaugers in assessing internal revenue tax on spirits.

I have not taken the time to verify all the references in parentheses above. Indeed, I was unable to do so with the ordinary reference books available to the student. It seemed, too, that in treating so simple and easily understood a subject, that it might be well to content myself with the above references, in order to show how simple the whole matter is, and what a delightful and satisfactory system we have, especially when exact measurements are needed. It is also probable that the careful reader will be stimulated by this hurried and incomplete account to investigate the subject further.

W. J. Spillman.

NEW AMERICAN OSTRACODA.

To the Editor of Science: In collections of ostracod crustaceans made near Greeley, Colo., in the last four months, I find a number of specimens of *Ilyocypris bradyi* Sars. A collection made from a small stream in central Illinois in August last, consists entirely of a species of *Ilyocypris*, allied to *I. iners* Kaufmann, which appears to be undescribed.

The genus *Ilyocypris* Brady and Norman is widely distributed in Europe but has not hitherto been found in America. Including the two forms above mentioned, the family Cyprididæ is represented in North America by 44 recognizable species comprised in 12 genera. Of these, 2 genera, comprising 3 species, are exclusively American; the remaining 10 genera are represented by 13 species common to Europe and North America, and by 28 species which have been found only in North America.

A full description, with drawings, of the *Ilyocypris* from Illinois is in preparation.

Arthur E. Beardsley.
State Normal School, Greeley, Colorado,
March 17, 1905.

SPECIAL ARTICLES.

THE DISTRIBUTION OF FRESH-WATER FAUNAS AS AN EVIDENCE OF DRAINAGE MODIFICATIONS.*

As the result of careful studies of stream development, it has been well established by a number of investigators that very important changes in the arrangement of drainage lines are often produced by the capture of a portion of the waters of one stream by a tributary of some neighboring stream. It is but seldom that the actual process of immediate capture is witnessed. We most frequently see the evidence of conditions which we believe will ultimately lead to capture, or results which we believe have been produced by capture sometime in the past.

Whenever one stream succeeds in capturing a portion of the drainage system of one of its neighbors, there are certain results which must necessarily follow, just as there must have been certain conditions present to make the capture possible. By a study of the results produced it is often possible to learn what were the former relations of streams in a given region, and so prove the fact of capture, and even the approximate time of its occurrence. The evidences of drainage modifications, therefore, are of prime interest to the student of geography.

It is not my purpose to review the several results which are produced when one stream captures another, but rather to direct attention to one of the results produced, and to consider its value as an evidence that capture has occurred. At the outset it is necessary to divide the features produced by river capture into two distinct classes: (1) those features which are produced by river-capture and which can be produced by nothing else; (2) those features which are produced by river-capture, but which may also be produced by some other agency. Features belonging to the first class are of themselves definite proofs that river-capture has taken place. As an example of this type of evidence we may note the occurrence, along the former course of the stream which has suffered capture, of river-brought gravels which are so distributed that they could have reached their present position only through the agency of the captured stream. Features of the second class, however, when taken alone can not be regarded as proofs of river-capture, since, according to the basis of classification, they may also be produced by other agencies. Considered by themselves they are only of suggestive value; other lines of evidence must be appealed to before the river-capture, of which they may be the direct result, can be proved to have taken place. As an example of this type of evidence we may cite the continuation of a broad, open valley along the former course of a large, mature stream which has been diverted by capture. A similar valley may also be produced by a relatively insignificant stream, provided it is working on a band of soft, easily soluble rock, as has been the case along certain headwater branches of the James and Roanoke rivers. The existence of such a valley alone is, therefore, not conclusive evidence of capture, however strongly it may seem to suggest it.

It is well known that different streams are often marked by certain peculiarities of the

* Paper read before the Philadelphia Meeting of the Association of American Geographers.

faunas which inhabit them. The fresh-water shells of one drainage system may be distinctly different from the shells found in the neighboring drainage systems on either side—so much so, in fact, that the student of these forms can often tell at a glance from what locality a given museum specimen has come. Now it is evident that if river-capture takes place, the shells of the captured stream will mingle with those of the capturing stream. Such a commingling of faunas becomes an evidence of drainage modifications, and it is with this type of evidence that the present paper is concerned. It is important to know whether this evidence belongs to the first of the two classes above outlined, being a positive proof of river-capture; or whether it belongs to the second class, and is, therefore, only of suggestive value.

The line of evidence in question is not new. It has already been advanced in support of a great example of supposed river-capture. The Tennessee River after flowing southward through eastern Tennessee to a point near the present city of Chattanooga, leaves its broad, open valley and turns abruptly westward through a deep, narrow gorge in Walden Plateau. Dr. C. W. Hayes and Mr. M. R. Campbell, in a paper on 'The Geomorphology of the Southern Appalachians,' published in 1894, advocated the theory that the Tennessee formerly continued on southward viâ the Coosa and Alabama rivers into the Gulf of Mexico, but near the close of the Tertiary period was captured at the point near Chattanooga by a branch of a stream farther west. Six years later Mr. Chas. T. Simpson, studying the fresh-water shells of this region, came to the same conclusion; and in a paper on 'The Evidence of the Unionidæ Regarding the Former Courses of the Tennessee and Other Rivers,' published in Science in 1900, independently supported the theory of capture on the basis of the biological evidence alone.

This latter line of evidence was urged as absolute proof of the supposed river-capture, it being held that the shells must have direct water communication in order to pass from one stream to another. It is true that elsewhere the author has advocated other means of dispersal than river-capture, but these means were not considered in connection with the Tennessee problem. In this case the whole strength of the argument lay in the statement, 'these forms can not travel overland from river to river, but must have water communication in order to pass from one stream to another.' And since shells peculiarly like those of the Tennessee drainage were found mingled with the usual forms of the Coosa and Alabama rivers the conclusion was reached that the Tennessee must have been diverted from a former southward course by capture near Chattanooga. The paper has been widely accepted and quoted as an example of the definite proof of river-capture, and some who could not accept as conclusive the physiographic evidence presented by Messrs. Hayes and Campbell in support of the theory of capture were impelled to regard the biological evidence a final proof that the capture had taken place.

In connection with a study of the Tennessee problem I have been especially interested in the evidence furnished by the distribution of the fresh-water faunas, and have become convinced that the evidence should be included in the second of the two classes above outlined, being produced by river-capture in some cases, but also being produced by other agencies as well, and, therefore, not being conclusive in favor of capture. The reasons for this will best appear if we consider some concrete case, as that of the Tennessee, in which this line of evidence has been especially employed.

The facts brought forth by a study of the Unionidæ are as follows: *Pleurobema,* a genus of Unio, has its metropolis in the Tennessee River. It is not found throughout the other portions of the Mississippi basin. But it is found abundantly in the Coosa and Alabama rivers. Also certain other forms of Unio common to the Mississippi-Tennessee basin are found in the Coosa-Alabama basin. From these facts it was concluded that at some time the upper Tennessee River must have flowed southward into the Coosa-Alabama River. On the basis of this line of argument we must necessarily assume that the fresh-water mussels require direct fresh-water communication in order to pass from one stream to another. It appears that the recorded observations of many naturalists and the facts of Unionidæ distribution are both contrary to this conception. In the first place, there are so many authentic cases where birds, insects, etc., have been taken with fresh-water shells attached to them, that students of the subject are compelled to accept this method of dispersion of these forms from place to place. Darwin proved that young molluscs just hatching will attach themselves to the feet of a duck, and remain alive in this position out of water from twelve to twenty hours. Mr. Arthur F. Gray, of Danversport, Massachusetts, had in his possession the foot of a water fowl to which was attached a bivalve shell. Canon Tristran shot a bird in the Sahara which had attached to it the eggs of some mollusc. Some shells attach themselves to plants which are carried away by birds (Darwin). Insects are frequently taken with shells attached. There are at least five recorded cases of the capture of the water-scorpion, *Nepa,* a large flying bug, with small shells attached. The great water-beetle, *Dytiscus,* is known similarly to aid in the dispersion of fresh-water mollusca. The same is true of *Dineutes.* Mr. Albert P. Morse, of Wellesley, has kindly shown me specimens of these last two forms having attached shells. *Notonecta* has likewise been proved to carry these forms from place to place. Some of these insects are powerful fliers. Darwin records the capture of one of them out at sea, forty-five miles from the nearest land. Beddard, Kew and other students of zoogeography regard birds and insects as undoubtedly important agents in the dispersion of fresh-water shells. Woodworth catalogues a number of agencies recorded as aiding in this dispersion, in addition to those mentioned above. It appears, then, that other means besides river-capture for the passing of fresh-water shells from one stream to another are not lacking. That these means are efficient is proved by the distribution of these shells. Ponds are sometimes made by excavating a place where no water stands ordinarily, lining the excavation with concrete and allowing the rain to fill it. These ponds, for a time devoid of life, gradually become populated with molluscs and other shells, proving, as Beddard says, the capacity for active or passive migration on the part of the Mollusca. Careful and successive observations have proved in some instances the actual time in which a given pond may become populated. R. Ellsworth Call records the presence of a western species of Unio in a small isolated eastern lake, which was located down between high hills, fed by a mountain brook, and absolutely foreign to any stream through which the species might have been introduced.

But the most conclusive objection to accepting this evidence as a proof of river-capture is found in the actual distribution of the very shells upon which the argument is based. The genus *Pleurobema* is found in both the Tennessee and Coosa-Alabama basins. In no case are the species in the two basins identical, but only similar. The basis of the argument, then, is similarity of forms. But if mere similarity of forms proves former river connection, certainly identity of form should prove it with double force. Accordingly we should not expect to find the same species of *Pleurobema* in any two rivers of this section whose location is such as to render practically impossible a former connection with each other. An examination of Mr. Simpson's important monograph on the pearly fresh-water mussels shows that *Pleurobema similans* Lea, is found in Black Warrior and Cahawba rivers, Alabama, and Pine Barren Creek, Escambia County, Florida. So far as can be judged from available maps, previous fresh-water communication between the former and the latter is extremely improbable. *Pleurobema strodeana* Wright, is recorded from Escambia River, Florida, and Flint River, Georgia. Any former connection in this case seems impossible. *Pleurobema harperi* Wright, is recorded from Altamaha and Flint rivers, Georgia, and Suwance River, Florida. Here, again, connection between either of the former and the latter seems out of the question. Other cases might be added—indefinitely, if we continue with other genera than

Pleurobema. If we find it impossible to hold river-capture responsible for the distribution of identical species in all these cases, then mere similarity of forms in the Tennessee and Coosa-Alabama basins can not be regarded as proof of river-capture near Chattanooga.

If we carry this line of argument to its logical conclusion, the objections to it become even more apparent. One group of Unios is recorded as occurring everywhere in the streams draining into the Atlantic from Labrador to Georgia. If the occurrence of the *Pleurobema* in the Tennessee and Coosa-Alabama rivers proves river-capture in that case, then the distribution just referred to must prove a great succession of river-captures from Labrador to Georgia. The same species is, in one instance, found in Europe, northern Asia, Japan, northern North America and Iceland. According to the argument advanced this means world-wide land connections and an inconceivable series of river-captures. Such violent hypotheses compel the conclusion that some other means than river-capture is most commonly operative in effecting the distribution of fresh-water shells.

It is believed that all the phenomena noted are easily explicable independently of the theory of capture, and, in this connection, it is well to note that the presence of a longitudinal, open valley across the low divide between the two basins is peculiarly favorable for the operation of some of the means of dispersal referred to above. The northward and southward migrations of birds along certain valleys is known, and where a low divide in a prominent valley alone separates the waters of two river systems it is to be expected that more or less mingling of forms will very likely take place.

In our consideration of this line of evidence it is of interest to recall Mr. Simpson's statements regarding the dispersal of these shells, which appear in his paper on the 'Distribution of North American Unionidæ,'* published seven years prior to his Tennessee paper. In a footnote (p. 354) he observes: "In many cases the Unionidæ seem to have had no difficulty in migrating across the country from river to river; an example of this being the Mississippi Valley species which inhabit all the rivers of Texas, and some of those of eastern Mexico; while on the other hand, species of South America extend up into Central America. The embryos, in some cases, may be carried by aquatic birds in the manner elsewhere mentioned in this paper; in others, they probably migrate across overflowed regions near the sea, in time of floods." Further on (p. 358), in accounting for the presence of *Unio luteolus* in both the Missouri and Columbia rivers, Mr. Simpson says: "I have traced it up the Missouri River to near its source, and when it is taken into consideration that the Marias, a tributary of this stream, heads within a few miles of Flathead Lake on Clarke's River, a branch of the Columbia, and that the embryos of Unios are provided with hooks by which they can attach themselves to the feet or feathers of aquatic birds, it is very easy to see how this species might have been carried from the waters of one drainage system to those of another."

It is believed, then, that the well-authenticated means of dispersal of mollusca, and more especially the facts of molluscan distribution, are such as to render it impossible to regard the distribution of fresh-water faunas as a conclusive evidence of drainage modifications. We must place this line of evidence in the second of the two classes outlined above—it being the result of river-capture in some cases, but being also produced as a result of other agencies. Whether the Tennessee River has suffered capture or not is a question which can not be settled on the basis of this class of evidence. Other sources must be appealed to. And while the Tennessee problem is a question in itself, it may not be amiss, especially in view of the wide attention attracted by the application of this line of evidence to that problem, to say that I have elsewhere pointed out certain objections to the theory of recent capture, and called attention to a variety of evidence now available

* 'On the Relationships and Distribution of the North American Unionidæ, with Notes on the West Coast Species,' *American Naturalist*, XXVII., 353–358, 1893.

which seems to indicate that the Tennessee has persisted in its present course for a long period of time.*

If the distribution of fresh-water faunas can not be regarded as a proof of river-capture, it is pertinent to ask, of what value is this class of evidence?

It seems to me that this will largely depend upon local conditions which must be taken into account in each individual problem. If there is a marked similarity or identity of forms in the captured stream and the stream representing the supposed former, lower course, and no such relation is found in any other two streams of the region, the evidence would be very suggestive. If the special forms thus distributed are so constructed anatomically as to be poorly adapted to dispersion by birds, insects, etc., the evidence would become much stronger. But if the divide between the two basins is low and indistinct and occurs in a broad, open valley along which aquatic birds are known to migrate habitually, and the shells in question are adapted to the various means of dispersal, then the opportunities for transference of forms between the two basins would be so excellent that the faunal evidence would be worthless as a proof of river capture. On the other hand, where no commingling of forms occurs, it might appear that no recent capture could have taken place and the evidence thus become of negative value. But even here we must take into consideration the restricted distribution of some forms along the same stream, due to the character of shores and stream bed, the intervention of falls or rapids and other features. Even where capture has taken place, the forms may not be transferred to the lower, new course of the stream, since they may not be found in the lower courses of streams long established in their present relations.

In conclusion, it is believed that the dispersion of fresh-water faunas is effected by so many different agencies, and the features of distribution are dependent on so many different factors, that such distribution can have but very limited value as an evidence of drainage modifications. In the cases where this evidence has already been offered as a proof of river-capture, it is believed that the conditions are such as to render its use invalid. It seems necessary to subject such evidence to unusually critical examination before *offering* it in support of any theory of drainage modifications, or *accepting* it as proof of the correctness of any such theory.

Douglas Wilson Johnson.

Department of Geology,
Massachusetts Institute of Technology.

* The full discussion of the Tennessee problem will appear in a forthcoming issue of the *Journal of Geology*.

CURRENT NOTES ON METEOROLOGY.

LONG-RANGE WEATHER FORECASTS.

The Weather Bureau has wisely published a *Bulletin* (No. 35) on the subject of 'Long-Range Weather Forecasts,' prepared by Professor E. B. Garriott, in order to counteract, so far as is possible, the misleading predictions for a month or a season in advance which are constantly finding their way into our newspapers. Indeed, such spurious long-range predictions are actually sold to the papers and to the public, and are most injurious in their effects. Long-range predictions are of various kinds, ranging from those based upon supposed planetary influences to such well-known statements, found in farmers' almanacs, as 'About—this—time—expect—showers,' these five words being so printed that they apply to a week or ten days of time. There are also other classes, based upon a careful study of sunspot periods, lunar periods, etc., some of which, as in the case of the recent investigations of Sir Norman Lockyer and Dr. W. J. S. Lockyer, seem to promise something in the way of more definite results. As to lunar influences, although much time has been spent on this matter, and faint lunar tides in the atmosphere have been made out near the equator, in the present state of our knowledge, as Angot put it two or three years ago, 'it can not be affirmed that the moon does exert any influence upon the weather, but at the same time it should not be denied that this influence may possibly exist.' As to seasonal predictions based upon the behavior and condition of animals, it is clear that the physical condition of the animal depends upon past weather conditions, and upon the food supply which those conditions have furnished, rather than upon future weather. The best that can be done at the present time is to make forecasts for one or two days in advance, and occasionally for three or four days. The future advance will depend upon a closer study of atmospheric pressure conditions over large areas, and of the influences which bring about normal or abnormal distribution of pressure.

THE LOW RELATIVE HUMIDITY OF WINNIPEG IN WINTER.

In a recent number of *Nature* (March 9, 1905) reference is made to some interesting electrical and other effects of the dry air of Winnipeg in winter, as reported by Professor Buller, of the University of Manitoba. The common experiment designed to show the presence of water vapor in the atmosphere, which is performed by exposing calcium chloride, has to be done in a damp-chamber. The substance shows no apparent signs of deliquescence even after some weeks' exposure to the ordinary air.

JELINEK'S METEOROLOGICAL INSTRUCTIONS.

A fifth edition of Jelinek's valuable 'Anleitung zu meteorologischen Beobachtungen' has been issued, under the direction of Dr. J. M. Pernter, the director of the Austrian Meteorological Institute. The fourth edition was dated 1903, and that, together with the third (1884), was revised by Dr. Hann. There are many admirable handbooks of instructions for meteorological observers, but this one has always stood in the front rank, and in its new edition, with many illustrations, is thoroughly up to date in every particular.

HANN'S LEHRBUCH DER METEOROLOGIE.

A new edition of Hann's invaluable 'Lehrbuch der Meteorologie' is on the way, the first part being already issued. There is no need of pointing out that the new edition will be thoroughly up to date, and that no teacher or student of meteorology can afford to do without it. It will consist of about six parts. Not the least of the many important additions will be the extension of the charts so as to include the recent important Antarctic discoveries.

A NEW RAIN GAUGE.

The *Meteorologische Zeitschrift* for January, 1905, contains a description of a new form of rain gauge designed by W. Gallenkampf, of Munich. The unsatisfactory character of the record made by the ordinary self-recording gauge, which does not show the details of rainfall sufficiently well, has led to the construction of a gauge from which the rainfall *drops*. Each drop falls on one end of a delicately-balanced arm, which descends under the weight, closes a circuit, and thus the fall of one drop is recorded. So detailed is the record that the rainfall curve can be plotted on the basis of the number of drops which fall from the gauge in half a minute, and these curves show clearly that the ordinary shower is very variable in its intensity, these smaller variations not being shown on the usual rain-gauge record. A number of curves illustrate the article, and throw a new light on the way in which our rain falls.

THE MICRO-BAROGRAPH.

In the *Quarterly Journal of the Royal Meteorological Society*, Vol. XXXI., 1905, pp. 39–52, Dr. W. N. Shaw and Mr. W. H. Dines describe an apparatus called the 'Micro-Barograph,' which has been designed to magnify the minor fluctuations and at the same time to disentangle them from the general barometric surges. The causes which suggest themselves as likely to produce temporary fluctuations of the barometric curves are the following: (1) Atmospheric billows passing along surfaces where there is discontinuity in density, in a manner similar to ocean waves; (2) the passage of minute whirls, or cyclonic depressions of small dimensions; (3) variations of pressure due to the attraction or repulsion produced by electric stress as masses of air at different potential pass by; (4) the mechanical effects of wind, and (5) the mechanical effects of the rapid condensation of aqueous vapor.

NOTES.

The effect of a severe drought upon meteorological observations is seen in the 'Report' of the Meteorological Commission of Cape Colony for 1903. There is a fair increase in the number of ordinary stations over 1902, but the rainfall stations show a decrease of 31. This is due to the fact that, owing to a drought, many farmers have 'trekked' with their cattle to adjoining territories, leaving their homesteads unoccupied.

Mr. D. E. Hutchins, of Cape Town, discusses the relation of the rainfalls of South Africa and of India during the period 1892–1902, and finds that the years of famine in India have been followed by years of bad drought in South Africa. The belief is expressed that the summer rains of South Africa have their origin in the moist winds from the Indian Ocean (*Nature*, Vol. 71, 1905, 342–344).

R. DeC. Ward.

A CONTEMPLATED MAGNETIC SURVEY OF THE NORTH PACIFIC OCEAN BY THE CARNEGIE INSTITUTION.

A project for a magnetic survey of the North Pacific Ocean by the Department of International Research in Terrestrial Magnetism has been favorably acted upon by the executive committee of the Carnegie Institution of Washington, and authorization has been given to begin the work this year. An initial allotment of $20,000 has been made to cover the expenses for the current year.

As is well known, the state of our knowledge of the distribution of the magnetic forces over the greater portion of the earth—the oceanic areas—owing to the paucity of precise data, is exceedingly unsatisfactory. This fact is especially true for that great body of water—the Pacific Ocean—rapidly developing in great commercial importance.

Captain Creak, for many years superintendent of the Compass Department of the British Admiralty, now retired, says: 'The North Pacific Ocean is, with the exception of the voyage of the *Challenger,* nearly a blank as regards magnetic observations, and I, therefore, think the magnetic survey proposed will be of great value.'

Hence, except for data from occasional expeditions and such as were acquired in wooden vessels a long time ago, the present magnetic charts used by the navigator over this region depend largely upon the observations on islands and along the coasts. Such land observations, however, are rarely representative of the true values because of prevalent local disturbances. It is, therefore, impossible to make any statement as to the correctness of the present charts. The demands of science, as well as those of commerce and navigation, require a systematic magnetic survey of this region under the most favorable conditions possible and that the work be done under the auspices of some recognized research institution in order to insure that the scientific aspects of the work receive their adequate recognition.

The eminent physicist and magnetician, Professor Arthur Schuster, states as his opinion: "I believe that no material progress of terrestrial magnetism is possible until the magnetic constants of the great ocean basins, especially the Pacific, have been determined more accurately than they are present. There is reason to believe that these constants may be affected by considerable systematic errors. It is possible that these errors have crept in by paying too much attention to measurements made on islands and along the sea-coast. What is wanted is more numerous and more accurate observations on the sea itself." Furthermore, the superintendent of the United States Coast and Geodetic Survey, Mr. O. H. Tittmann, says: "There is no doubt in my mind that a survey for that purpose would result in obtaining data of great and permanent value and that it should be undertaken."

Additional quotations could be given; the above, however, are representative and show sufficiently the great importance of the proposed work and the fruitful results that may confidently be expected. It is the hope that upon the completion of the magnetic survey of the North Pacific, the means will be forthcoming for extending the survey so as to include other oceanic areas. An effort will, furthermore, be made to secure the interest and cooperation of all civilized countries, so that we may look forward to the completion of a general magnetic survey of the accessible portions of the globe within about fifteen years. Thanks to the awakening and renewed interest in magnetic work shown on all sides, I fully believe that this hope will be realized.

The matter of prime consideration in magnetic work at sea is the elimination of the effects resulting from the ship's own magnetism as due to her construction and equipment. Such effects are especially troublesome to eliminate when it is proposed to obtain not only the magnetic declination at sea, but also the other magnetic elements (the dip and the intensity of the magnetic force). The plan, therefore, to be attempted this year, as worked out by Mr. G. W. Littlehales, hydrographic engineer of the United States Hydrographic Office and consulting hydrographer of the Department of Terrestrial Magnetism of the Carnegie Institution, is in brief as follows: "To charter a wood-built, non-magnetic, sailing vessel of about six hundred tons displacement, which, starting out in summer from San Francisco, shall pursue a clockwise spiral course embracing the entire North Pacific Ocean. The object of planning such a course is to gain continuous advantage throughout the survey of the dynamical agencies of the atmosphere and the ocean, in passing in succession into each of the five-degree quadrangles into which the chart* is divided and in which observed values of the three magnetic elements need to be obtained.

"The seasonal shifting of the permanent centers of barometric pressure will cause a variation from month to month of the conditions of wind and current that are represented on this particular chart, but if the departure from San Francisco be taken in the summer, the chain of meteorological events will contribute toward the maximum progress over the course, passing thence along the west coast of America to the vicinity of the Galapagos Islands, thence across the Pacific in latitude between two and three degrees north, thence along the eastern side of the Philippine Archipelago and the empire of Japan, thence eastward in about latitude fifty-two degrees north, thence to the latitude of San Francisco, and thence continuing through the series of areas bounded by parallels of latitude and meridians of longitude each five degrees apart, lying next on the midocean side of the circuit last made, and proceeding gradually and by successive circuits into the central region of the North Pacific."

* The course to be followed was shown in red ink on a U. S. Hydrographic Office Pilot Chart of the North Pacific.

The total length of the course marked out is about 70,000 knots; however, each of the first circuits practically closes at San Francisco, so that, if it is found that the method pursued is not the best, the work can readily be terminated or modified. From inquiries made, it would appear that the entire work of observation and reduction can be accomplished in three years. The cost per month of the field work, inclusive of all expenses and services, will approximate $1,500. Counting eight months of continuous service per annum, the total annual outlay is estimated at about $12,000.

This project as the result of careful consideration and solicitation of expert opinion is believed to be thoroughly feasible. It permits of useful comprehensive results being immediately obtained, and is one which can be interrupted without any important waste of antecedent expense, whenever circumstances may render a discontinuance or a modification of the original plan advisable.

The region it is proposed at present to survey fortunately contains magnetic observatories in requisite number and proper distribution for furnishing the necessary corrections to be applied to the observed magnetic elements in order to reduce them to a common epoch. Thus continuous records of the magnetic variations required for this purpose will be available from the following stations: Sitka, Mexico, Honolulu, Manila, Shanghai, Tokio. In addition it is hoped that there may be soon a magnetic observatory in California or vicinity for lending effective cooperation, and that the German government will continue its magnetic observatory at Apia throughout the period of the survey. Also excellent opportunities for controlling instrumental constants and obtaining required additional data will be afforded by stations on the coasts and on islands.

It should also be pointed out that the plan of the courses as mapped permits ready adjustment of the observed quantities for closed areas, in accordance with the potential hypothesis, and it may permit to a certain degree the testing of the accuracy of this assumption, though as regards the latter more can be said at the end of a year's work.

While it is not anticipated that any marked irregularities in the distribution of the earth's magnetism will manifest themselves over the deep waters of the Pacific, it may confidently be expected that in the neighborhood of the islands and along the coasts distortions and irregularities will be revealed. With the aid of the results of the detailed magnetic survey of the United States and Alaska, opportunity will, therefore, be afforded of studying the effect of the configuration of land and water upon the distribution of the magnetic forces. The first circuit, passing as it does along the American and Asiatic coasts, will yield especially interesting results in this respect. Thus, for example, along the Aleutian Islands marked local disturbances will be disclosed. Reports are received frequently from mariners in this region regarding the unsatisfactory behavior of the compass; it is, therefore, greatly to be desired that a systematic magnetic survey of the waters in this region be made.

Additional information regarding the expedition will be given later.

L. A. BAUER,
Director.
DEPARTMENT OF TERRESTRIAL MAGNETISM,
CARNEGIE INSTITUTION,
WASHINGTON, D. C.

THE ELIZABETH THOMPSON SCIENCE FUND.

THE thirtieth meeting of the board of trustees was held at the Harvard Medical School, Boston, Mass., on March 17. The following officers were elected:

President—Henry P. Bowditch.
Treasurer—Carles S. Rackemann.
Secretary—Charles S. Minot.

The report of the treasurer, showing a balance of income on hand of $1,237.79, was accepted and placed on file. The secretary reported that the following grant had been made:

No. 116, $150, to W. Bateson, Esq., for experiments on heredity in rabbits, to be conducted under Mr. Bateson's direction by Mr. C. C. Hurst.

Reports of progress were received from the following recipients of grants:

No. 27. E. Hartwig.
No. 60. F. Kruger.
No. 94. A. M. Reese.
No. 96. H. E. Crampton.
No. 98. J. Weinzirl.
No. 101. T. A. Jaggar, Jr.
No. 103. E. Anding.
No. 106. W. Valentiner.
No. 107. M. W. Travers.
No. 108. B. L. Seawell.
No. 109. A. Nicolas.
No. 110. H. S. Grindley.
No. 111. R. Hürthle.
No. 112. W. J. Moenkhaus.
No. 113. S. P. Fergusson.
No. 114. W. Rosenthal.
No. 115. H. S. Carhart.
No. 116. W. Bateson.

The work having been completed and published, it was voted to close the records for the following grants:

No. 71. A. Nicolas.
No. 79. H. S. Grindley.
No. 100. H. H. Field.
No. 102. E. O. Jordan.
No. 104. W. P. Bradley.

It was further voted that the work having been completed, the records of the following grants should be closed, when copies of the published results were received by the trustees:

No. 65. O. Lubarsch.
No. 73. J. von Kennell.
No. 83. W. L. Tower.

Mr. F. W. Bancroft, who held grant No. 97, reported that his experiments had been made for the transplantation of ovaries in rabbits, but that he had not succeeded in obtaining ova from such transplanted ovaries. It was deemed, therefore, inadvisable to continue the research, and it was voted to close the record of his grant, and to allow him to use the material which he had on hand for other researches.

The secretary reported that thirty-one applications for grants had been received, the total amount asked for being nearly $9,000. After a thorough discussion and extended deliberation, the board found itself obliged to refuse a number of applications of high merit to which it would have been very glad to extend aid, had the resources of the fund permitted. It was voted to make the following new grants:

No. 117, $100 to Professor E. Salkowski and Dr. C. Neuberg, Berlin, Germany, for an experimental study of glycuronic acid. (Application 966.)

No. 118, $200 to Professor Th. Boveri, Würzburg, Germany, for an experimental study of the early development of sea urchin eggs. (Application 981.)

No. 119, $100 to Professor J. P. McMurrich, Ann Arbor, Mich., for the study of Actinians from the Malayan Archipelago. (Application 984.)

No. 120, $50 to Professor E. H. Archibald, Syracuse, N. Y., for researches on the electrical conductivity of solutions of organic bodies in the liquefied halogen hydrides. (Application 987.)

No. 121, $200 to Professor A. Debierne, Paris, France, for the isolation and study of Actinium. (Application 988.)

No. 122, $200 to Dr. Fr. Nušl and J. J. Frič, Prague, Austria, for perfecting an instrument for the determination of latitude and time without the use of levels. (Application 991.)

No. 123, $200 to Professor E. C. Jeffrey, Cambridge, Mass., for the study of cupressineous conifers. (Application 998.)

No. 124, $150 to Professor P. Bachmetjew, Sofia, Bulgaria, for the study of the anabiotic condition in warm-blooded animals. (Application 999.)

Charles S. Minot,
Secretary.

MEDALS AND AWARDS OF THE ROYAL GEOGRAPHICAL SOCIETY.

The London *Times* states that with the approval of the king, the council of the Royal Geographical Society has decided to award the two royal medals for this year to Sir Martin Conway (Founder's Medal) and Captain C. H. D. Ryder. R.E. (Patron's Medal).

During a long series of years Sir Martin Conway has devoted himself to the exploration of various mountain regions of the world—the Alps, the Himalayas and the Andes; and, further, has done useful work among the islands of Spitsbergen. In a series of papers and maps contributed to the society, as well as in separate publications, he has made, as a result of these explorations, large and valuable contributions to geographical knowledge.

Captain Ryder's claim to a Royal Medal rests mainly on the important and extensive work which he accomplished while acting as principal survey officer on the recent Tibet Mission. Not only did he execute a large amount of survey work and mapping while on the main expedition, but as survey officer in the expedition into Western Tibet he surveyed and mapped the Upper Brahmaputra to its source, as well as the Sutlej and the Gartok tributary of the Indus. He also surveyed the whole of the line of mountains lying north of the Himalayas, and proved that there is no peak that can approach Mount Everest in altitude. Before these experiences Captain Ryder, in 1899–1900, carried out a careful survey of the province of Yunnan, the results of which, comprising a map radically altering those previously compiled, he contributed to the society.

This year an award is again made of the Victoria Research Medal, which was instituted on the death of Queen Victoria, and is bestowed as occasion may arise in recognition of distinguished service to the cause of geographical research, as distinguished from exploration. The new recipient—the third to receive the medal—will be Mr. J. G. Bartholomew. During many years Mr. Bartholomew has done much to raise the standard of cartography in Great Britain. He has edited and issued large atlases of England and Scotland; he has planned and issued the first volume of a great physical atlas which will take the first place among works of its kind; he has for years been collecting material for a complete atlas of the British Empire. All this has been achieved at his own expense, and has entailed the expenditure of thousands of pounds, which he can never hope to recover.

Of the society's minor awards, the Murchison Grant goes to Mr. William Wallace, C.M.G., Deputy High Commissioner of the Northern Nigeria Protectorate. During the many years he has served as an official in Northern Nigeria, Mr. Wallace has rendered great service to exploration and geography, both directly and indirectly. Colonel F. R. Maunsell, R.A., is awarded the Gill Memorial for his explorations during many years' residence in Asia Minor, and in particular for the large map which he has compiled, largely from his own materials, and placed at the disposal of the society. The recipient of the Cuthbert Peek Grant is Mr. Francis J. Lewis, who has made valuable contributions to the knowledge of botanical distribution by his researches into the geographical distribution of vegetation in the North of England. Finally, Captain Philip Maud, R.E., is designated to receive the Back Grant for valuable survey work in 1903 along the southern border of Abyssinia.

PROFESSOR WILHELM OSTWALD AT HARVARD UNIVERSITY.

Harvard University has invited Professor Wilhelm Ostwald, of the University of Leipzig, to serve as lecturer in the first half of the coming academic year, under the arrangement for an exchange of professors which has recently been agreed upon by Harvard University and the German Government. Professor Ostwald is regarded as one of the founders of the modern science of physical chemistry; and he has achieved a position of the highest rank in the scientific world, not only as an investigator and thinker, but also as a reformer, organizer and teacher in the field of natural science. With J. H. van't Hoff, Ostwald founded in 1887 the *Zeitschrift für physikalische Chemie,* and in 1901 the *Annalen der Naturphilosophie.* In 1904 he gave the Faraday lecture before the Royal Society. He has been a prolific and indefatigable investigator and writer, and a list of his publications would occupy several closely printed pages. Although he achieved eminence first in the field of physical chemistry. Professor Ostwald has during the last four or five years diverted, or perhaps rather extended, his studies to the broad field of the philosophy of science, a subject to which one of his best-known works, as well as the *Annalen* above mentioned, is devoted.

Professor Ostwald has not yet definitely announced the subjects of the courses which he will give during his residence at Harvard. It is hoped, however, that he will give one course counting for a degree on the history of science, a course which would be of interest to students in all branches of science as well as to students of philosophy. It is also hoped that he will announce one or two courses in his special field of physical chemistry, thus affording a rare opportunty to graduate students in chemistry who may be in residence next year.

Friedrich Wilhelm Ostwald was born in the city of Riga in Russia September 2, 1853. He attended the Kronsknabenschule and the Realgymnasium of Riga, showing as a schoolboy a remarkable talent for writing and drawing, which he put into use as editor of a schoolboy magazine. In 1872, against the wish of his father, who thought to make an engineer of him, he entered the University of Dorpat in Russia to pursue the study of chemistry. In 1875 he became an assistant in physics to von Oettingen. He took the master's examination at Dorpat in 1877 and the doctorate in 1878. In 1879 he began his teaching career as a privatdocent, and in the same year exchanged his assistantship in physics for one in chemistry under Carl Schmidt. In 1881 he was called to a professorship of chemistry at the Polytechnikum in his native city, and held this place until 1887, when he accepted an appointment as professor of physical chemistry at Leipzig—the position which he still holds. Professor Ostwald was one of the delegates to the International Congress of Arts and Science at St. Louis last year.

A CONFERENCE OF ANATOMISTS.

Invitations have been issued by the Wistar Institute of Anatomy, Philadelphia, to ten of the leading anatomists of the United States to participate in a conference in the interests of anatomy in America. Two sessions of this conference were to be held in the library of the Wistar Institute, on April 11 and 12, beginning each day at 10:30 A.M. The object of this conference is to discuss the possibility, advisability and means of organizing central institutes for the promotion of research in the different subdivisions of anatomy such as physical anthropology, comparative anatomy, topographical anatomy, embryology, histology and neurology, and to establish relationship with similar institutes abroad. The conference was proposed by Dr. M. J. Greenman, director of the Wistar Institute, and the following anatomists are expected to be present: Dr. Lewellys F. Barker, professor of anatomy, Chicago University; Dr. Edwin G. Conklin, professor of zoology, University of Pennsylvania; Dr. Henry H. Donaldson, professor of neurology, University of Chicago; Mr. Simon H. Gage, professor of embryology, Cornell University; Dr. G. Carl Huber, professor of embryology, University of Michigan; Dr. Geo. S. Huntington, professor of anatomy, Columbia University; Dr. Franklin P. Mall, professor of anatomy, Johns Hopkins University; Dr. J. P. McMurrich, professor of anatomy, University of Michigan; Dr. Chas. S. Minot, professor of embryology, Harvard University; Dr. George A. Piersol, professor of anatomy, University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

The National Academy of Sciences will hold its annual stated session at Washington, beginning Tuesday, April 18.

The American Philosophical Society is this week holding its general meeting at Philadelphia.

Dr. R. S. Woodward, president of the Carnegie Institution, was given a dinner by his colleagues at Columbia University, at Delmonico's, on April 4. Speeches were made by President Butler, Mr. Andrew Carnegie, Dr. John S. Billings, Professor E. B. Wilson and President Woodward.

Dr. H. A. Lorentz, professor of physics in the University of Leyden, and Professor V. F. Bjerknes, professor of mathematical physics in the University of Stockholm, will give courses of lectures at Columbia University next year.

Professor Henry S. Carhart, who holds the chair of physics at the University of Michigan, and Professor W. B. Scott, who holds the chair of geology at Princeton, have been invited to join the official party to attend the South African meeting of the British Association for the Advancement of Science this summer.

Professor R. W. Wood, of the department of physics of the Johns Hopkins University, and Dr. H. S. Jennings, of the zoological department of the University of Pennsylvania, have been elected honorary fellows of the Royal Microscopical Society of Great Britain.

Professor Hugo de Vries, professor of botany at Amsterdam, has been made a foreign member of the Belgian Academy of Sciences.

Professor E. von Drygalski has been elected a foreign member of the Geographical Society of Vienna.

The Fothergillian prize of the Medical Society of London for 1905 has been awarded, by the council of the society, to Sir Frederick Treves in recognition of the value of his work in connection with abdominal surgery.

Professor William H. Pickering, of the Harvard College Observatory, will observe the total eclipse of the sun on August 30, in Algeria.

Professor Albert M. Reese, of Syracuse University, will go to Florida at the end of May under the auspices of the Smithsonian Institution to collect eggs of the alligator with which to work out its embryology; subsequently he will spend some time at the biological laboratory of the Carnegie Institution on the Dry Tortugas.

Dr. Marcus S. Farr, curator in the Department of Paleontology, Princeton University, will again this year conduct an expedition to Wyoming and Montana.

At the meeting of the Physicochemical Club of Boston and Cambridge, at Harvard Union, on March 27, Professor A. A. Noyes spoke on the conductivity of certain acids, bases and salts up to 218°, and Professor T. W. Richards spoke on the elimination of thermometric lag and the cooling correction in accurate calorimetry.

On the anniversary of the death of Dr. Charles E. Beecher, who held the chair of paleontology at Yale University, his portrait was hung in the registrar's office.

Professor Albert A. Wright, since 1874 professor of geology and zoology at Oberlin College, died at Oberlin as the result of a stroke of paralysis on April 2, at the age of fifty-nine years.

We regret also to record the death of M. Victor Raulin, emeritus professor of geology at Bordeaux, at the age of ninety years, and of M. Julien, professor of geology at Clermont-Ferrand, at the age of sixty-five years.

There will be a civil service examination on May 10 to fill at least three vacancies in the position of civil engineer student in the Division of Tests, Bureau of Chemistry, Department of Agriculture, at not exceeding $50 per month each.

A New York state civil service examination will be held on April 22 to fill the position of histological laboratory assistant in the Pathological Institute at a salary of $1,200. The position is open to both men and women.

A consular report states that the erection of the institute for cancer investigation, to be in the immediate vicinity of the Academy Hospital at Heidelberg, will be begun as soon as possible, and its completion is expected in the spring of 1906. It will be the first larger institution of its kind in Germany, and probably in Europe, where scientific investigation will be combined with treatment of patients. While the lower floor will serve exclusively for making bacteriological, pathological and other researches, and while the entire equipment will reflect the most modern scientific knowledge, the second floor will accommodate about forty patients who may expect temporary or permanent relief. The first impetus for this institute was given by an unknown party, who nine months ago donated the sum of 150,000 Marks for this purpose, on condition that it should be used exclusively for a hospital at Heidelberg devoted to cancer investigation. Other unknown donors have increased the fund to about $60,000. The government of the Grand Duchy of Baden, in accepting the trust on the part of the Grand Duke, has furnished the ground for the building and consented to manage the institution, for which purpose a considerable appropriation will be made.

UNIVERSITY AND EDUCATIONAL NEWS.

The authorities of Stevens Institute of Technology have taken up vigorously the task of raising the additional $100,000 required to render available the $100,000 conditionally donated by Mr. Andrew Carnegie and President Alexander C. Humphreys ($50,000 each) at the recent dinner of the Stevens alumni. It is expected that the alumni will heartily cooperate by contributing and by awakening the interest of their friends.

The chair of social and political ethics at Columbia University, held by Professor Felix Adler, has been endowed. The university has also received $10,000 from Mr. F. L. Stetson towards a building for the Law School.

Dr. Lewellys F. Barker, professor of anatomy at the University of Chicago, has been called to the chair of medicine in Johns Hopkins University, vacant by the removal of Dr. William Osler to Oxford. At the same time Dr. W. S. Thayer, associate professor of medicine, has been advanced to a professorship of clinical medicine.

Dr. B. B. Gallaudet, demonstrator in anatomy at Columbia University, has been appointed adjunct professor, and Dr. W. P. Montague, tutor in philosophy, has been made instructor.

Thomas C. Esty, professor of mathematics at Rochester University, has received a call to a similar position at Amherst, where he will succeed his father, Professor William C. Esty, who has been an instructor at Amherst for forty-three years.

Wm. A. Hilton, Ph.D., formerly assistant in histology and embryology in Cornell University, has been appointed to the chair of biology in Pomona College for the coming year.

SCIENCE

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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 21, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ALBERT BENJAMIN PRESCOTT.

DR. ALBERT BENJAMIN PRESCOTT, director of the chemical laboratory at the University of Michigan, died at his home in Ann Arbor, February 25, 1905. He was the senior member of the university faculty, and one of the veterans of American science.

Dr. Prescott was born at Hastings, N. Y., December 12, 1832. Educated as a physician, he took the degree of M.D. in 1864, and in that year and part of the year following, he served as an assistant surgeon in the United States Volunteer Army. In 1865 he became assistant professor of chemistry in the University of Michigan; was made full professor of organic and applied chemistry in 1870; and was dean of the school of pharmacy since 1870; and from 1884 to the day of his death, was director of the chemical laboratory. His whole professional life as a chemist was spent in the service of the university, as teacher, organizer, administrator and investigator during a period of forty years.

In a career like that of Dr. Prescott there is nothing sensational or spectacular. It was a life of obvious duties, uniformly well done, with nothing slighted, and no strivings after public recognition. Recognition, nevertheless, came to him unsought, and he had the satisfaction of knowing that his work was appreciated. He became president of the American Chemical Society, the American Association for the Advancement of Science and the American Pharmaceutical Association; honors as high as any that American scholarship can confer. From the University of Michigan in 1896 and from Northwestern University in 1903 he received the honorary degree of LL.D.; in 1898 he was made a member of the American Philosophical Society; and in 1904 he presided over the section of organic chemistry in the International Congress at St. Louis. The list of honors might be lengthened, but these examples are enough to show the esteem in which Dr. Prescott was held by those who knew him best and were most competent to appraise his merits.

As a teacher Dr. Prescott was singularly successful, both in his personal relations with his students and as an organizer of reforms. He began his work at a time when lectures and recitations were commonly thought to be adequate instruments for scientific teaching; and when laboratory practice for students was a questionable novelty which only a few American schools had dared to try. From the beginning he took his stand on the side of modern methods, and organized his work along practical lines. The teaching of chemistry in schools of pharmacy and medicine was notably advanced through his efforts; and given a significance which, in this country at least, it had not had before. In this respect Prescott was one of several leaders; less conspicuous, perhaps, than some others, because of his modesty and quiet ways, but none the less potent and influential. He labored unpretentiously, but the results which he sought to accomplish were attained. The admirable organization of chemical work in the University of Michigan is the outcome of Prescott's broad and liberal views.

No man can escape the influences of his environment. The work that comes to him is the work that he must do. In Dr. Prescott's case, the requirements of his position with respect to medicine and pharmacy, naturally forced him into the study of organic compounds, but not along the conventional lines. Theoretical problems occupied little of his attention; but analytical methods, especially in the domain of toxicology, and the investigation of proximate principles, such as the alkaloids, took a large part of his time. His researches upon the alkaloidal iodides, and upon the assay of opium, placed him easily first among American specialists in that class of studies. His 'Outlines of Proximate Organic Analyses,' published in 1875, was the first text-book of its kind in the English language, and it brought him an extended reputation. In the same year he published a monograph upon 'The Chemical Examination of Alcoholic Liquors,' which made him still more widely known. In 1888 he issued a 'Manual of Organic Analysis,' and he also contributed a fair amount to the general literature of analytical processes. Douglas and Prescott's 'Qualitative Chemical Analysis' has been a standard text-book for thirty years.

Dr. Prescott's position in a state university naturally brought him into public service in connection with sanitary affairs. The adulteration of food and the detection of foreign fats and coloring matters in butter were subjects to which he gave much attention, and in which he was of material assistance to the food commissioners of Michigan. Questions of water-supply and filtration were often submitted to his judgment, and in these ways his public usefulness extended far beyond the limits of his state. Unfortunately, work of this kind brings little glory to a man, but its value must not be underestimated. It contributes greatly to the public welfare, and it can be properly done only by one who is thoroughly faithful and conscientious. Such a man was Prescott, whose work was honest from beginning to end.

Dr. Prescott early recognized the value of research as a means of education, and so his students often shared in his investigations. A perfect list of his contributions to chemistry has not, I think, been prepared; but it would be by no means a short one. No brilliant or startling discovery fell to his lot, but then few chemists are so favored. A large volume of good work, well done, is all that most men can aspire to, and in that respect Dr. Prescott's reputation is secure. Those who knew him will think most of the man himself, rather than of his achievements. He was kindly, modest, sincere and lovable; and what better can be said of any one?

Dr. Prescott was married to Abigail Freeburn in 1866. His widow and one son survive him.

F. W. CLARKE.

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*THE USE OF COPPER IN THE PURIFICATION OF WATER SUPPLIES.**

DR. GEORGE T. MOORE, physiologist and algologist, Bureau of Plant Industry, said: Probably the best way in which to present the question of the use of copper salts in the purification of water supplies, is to give briefly a history of the subject, outlining in a general way how the method came to be used, and some of the results obtained by the Department of Agriculture. It may seem a little out of the province of this department to experiment upon the purification of water; but, as you know, the present Secretary of Agriculture is so ready to take up anything new that promises profitable results along any line not already occupied, that he was very glad and willing to allow an investigation to be undertaken which promised to afford relief to so many. Consequently, with the consent of Congress and with the very able cooperation of Dr. Galloway and Mr. Woods, of the Bureau of Plant Industry, this particular investigation was undertaken in the Laboratory of Plant Physiology. Those of you who have had any experience with attempting to drink water where it has the so-called pigpen or fishy taste will readily recognize the importance of finding some means of preventing this disagreeable condition. New England is probably the most notorious region for having this fishy odor and taste in its water supplies, but this difficulty is by no means confined to any particular part of the country. There is practically no state in the union which has not reported the greatest trouble due to the plants producing bad odors and tastes in water, for in almost all cases it is the growth of certain aquatic plants called algæ which is responsible for the difficulty.

I will not try to give you a list of the towns and cities in the United States which, because of the presence of these plants, have had most serious times with their water reservoirs. The importance of the subject is so great that at least one water commission considered it worth $4,000,000 to take precautions against the appearance of algæ in their reservoir, and in many instances hundreds of thousands of dollars have been expended in a vain attempt to prevent the bad odors and tastes which have occurred annually.

It so happens that in my mail to-day there came a letter from a town, the name of which I will not mention, which perhaps describes the general situation incident to having a water polluted by these vegetable growths, as well as a long discussion.

> The reservoir of T—— is (to put it in plain Anglo-Saxon) fierce. We are able to drink it only in the winter and early spring. During the summer and fall of the year it is so foul that it can not be used even to wash clothes. Never in all my experience in various towns and cities have I found such water, and yet physicians have analyzed it and found it all right. In the summer it is yellowish in color and the odor is rank, being perceived at once on opening the faucet.

There are many similar communities where the water, during the summer

* Report of meeting held January 5, by the Washington Academy of Sciences.

months, at least, is so foul that people have to discontinue sprinkling the lawns and in some cases the reservoir can be detected—by the nose—over a half mile away. Now, as this letter says, examinations of an algal-polluted water usually show it to be harmless so far as man is concerned, but because of the odor and taste it might just as well be poisonous. People can not use it, and for this reason they are frequently driven to use polluted wells and springs, or bottled waters, which by no means are always free from disease germs. In this way, epidemics have been known to arise, due to the presence of algæ in the city water which, of itself, contained no pathogenic organisms. A problem of so much sanitary and financial importance has naturally received much attention from water engineers and others. However, the recommendations usually made of aerating the water or covering the reservoir have been either ineffective or too expensive, and up to within a short time the problem of how to get rid of the bad odors and taste in water has been considered impossible of solution. The principal means of avoiding such difficulties has been to abandon the reservoir, create a new system of supply and hope the old condition would not return until the water company or the town could afford to install another plant. Filtration offered little or no relief; indeed, filtered water, stored in an open reservoir, is often more subject to algal pollution than any other kind. Consequently, this problem of how to prevent the growth of algæ in water for domestic purposes had been practically abandoned as impossible by many of those most closely concerned with water supply work.

It seemed necessary, therefore, to take up the question along some entirely new line and, consequently, careful investigations were undertaken regarding the life history of the particular organisms concerned and an attempt was made to find some toxic element which, although fatal to the plants, would yet be absolutely harmless to man. It is not necessary to consider the large number of substances that were experimented with, but, of course, it was very soon found that the heavy metals were more effective than anything else that could be used on a practical scale. The fatal effect of copper upon algæ has been known for a long time and our own experiments seemed to demonstrate that it was more efficient than anything else sufficiently cheap and easily obtained. Therefore, it was decided to carry on experiments on a large scale with this metal alone.

The three points, of course, necessary in determining a means of destroying algæ is that it shall be thoroughly efficient; that it shall be cheap—for, of course, there must be no limit to the amount of water treated—and finally it must be harmless to man.

First, in regard to the efficiency, I will give the result of a few experiments which demonstrate what high dilutions of copper sulphate will do to algæ.

The first opportunity which presented itself for experimenting on a large scale was in the cress beds of the South. Here the conditions were such that after the cress had been cut and before the new growth could start, a thick heavy mat of algæ would form over the surface of the water sufficient to prevent the growth, if not entirely smother out the delicate cress plants. Since water cress at that time of the year was worth about $20 a barrel, and the demand was considerably greater than the supply, a large amount of money was being lost in this way, and it seemed worth while to experiment with these beds and see if it would not be possible to exterminate the algal growth without destroying the cress. Consequently, a solution of copper sulphate was prepared of a strength of about one to fifty million parts of water, and this was applied to the algal mass in hopes that it would accomplish the desired result. In a very short time all of the algal growth was exterminated, and although the first application was made in the fall of 1901, it has never been necessary to apply copper more than once a year to these beds. Naturally, the degree of success attained in this work, while not in any way demonstrating that a similar method would be efficacious in large reservoirs, seemed to warrant a more thorough investigation of the subject.

In June, 1903, our attention was called to the condition of the reservoir at Winchester, Ky. This supply was constructed in 1890, and after the first three years a strong odor and taste were noticeable in the water during the hot summer months. This condition gradually increased until the water attained such a degree of offensiveness as to make its use for any purpose almost intolerable. Aeration and mechanical filtration were tried without effect, and it seemed that the only hope for relief was to abandon the entire reservoir and go ten miles to the Kentucky River for the source of a new supply. The cost, however, was too great to be considered, and for this reason the difficulty was considerably increased. A microscopical examination of the water showed that the odor and taste were due to the presence of one of the blue-green algæ, and it was believed that the application of copper sulphate at the rate of about 1 to 5,000,000 would be sufficient to destroy these forms; consequently, there being no objection on the part of either the water board or the health authorities, a treatment was made, and the results have been everything that could be desired. Within three or four days the odor disappeared and the water was perfectly clear. This summer at about the same time it was feared that the algal growth was reappearing, and for this reason another slight treatment was made, but with this exception, no copper has been added to the water since the original treatment in June, 1903, and it has remained perfectly clean and sweet.

In 1892 the Butte (Montana) City Water Company began the construction of a large impounding reservoir for the purpose of storing the water of a mountain stream having its source in the summit of the Rocky Mountains. The next year the stored water became badly contaminated and was unfit for domestic use on account of its disagreeable odor and taste. In 1894 the dam was increased so that the capacity of the reservoir was 180,000,000 gallons, but the same trouble was experienced as during the previous year, and further work was stopped on the dam until some remedy could be discovered. An extensive study of the conditions to discover the cause and find a remedy for the trouble was undertaken, and, besides a resident chemist and bacteriologist, consultations were held with water engineers of note in all parts of the country. It was finally decided to increase the water supply flowing into the reservoir and more thoroughly clean the bottom of all organic matter which might contain vegetable organisms. Notwithstanding the efforts made in this line, the water was so infected with algæ as to be absolutely nauseating in odor and taste, and it became so offensive that the odor was continually present in the city on account of the water being used in sprinkling carts. On July 7 of this year copper sulphate was added to this reservoir in the proportion of 1 part to 8,500,000 parts of water. During the first twenty-four hours the water in the reservoir gave off a most pronounced and disagreeable odor, and at the end of the second and third days changes were noticed in the color and taste of the water, particularly in the lower depths. By the end of the fifth day the water assumed a natural color and only a slight odor and taste were noticeable on the surface. On Sunday, July 24, the water in the reservoir, being absolutely pure, for the first time in ten years, during the summer months, was turned into the city mains, and since this date has been in constant use.

Many other examples might be given of the efficiency of copper sulphate as a preventative of algal pollution, but it is probably sufficient to say that over fifty large water supplies have been successfully treated during the last six months, and in no instance where a supply was in actual use and the method applied according to directions has it failed to accomplish the desired result.

It is not necessary to dwell upon the question of cost. In general this may vary from ten cents to fifty cents per million gallons, and no water company is likely to hesitate at this amount if it enables them to get rid of a difficulty which often causes them an annual expense of thousands of dollars, to say nothing of the complaints of consumers.

The fact that copper has been used in a number of water supplies in quantities of from one to a million to one to ten or fifteen millions without causing any perceptible difficulty might be regarded as evidence in favor of the harmlessness of copper to man, or at least as demonstrating that this metal is not poisonous in the generally accepted sense of the word. There is, however, a deep-seated prejudice against copper in the popular mind, and it is difficult to convince the public that the cases of poisoning supposed to have been due to eating food from copper utensils were due to other causes, now well recognized. Perhaps there will always be a certain amount of opposition to the use of copper, just as there is to antitoxin and vaccination. After all, the question is a local one which must be decided by the local authorities, and if there is any question about the method it should not be resorted to. Certainly, the Department of Agriculture does not wish to insist upon the use of copper sulphate without the hearty consent of the authorities who have the control of the water supply, and this consent has always been obtained before any work of this kind has been carried on.

The fact that we daily consume in our food quite as much, if not more copper, than would ever be added to a water supply is not generally known by the public; not only in peas and other canned goods, where copper has been added for a purpose, but in meats, fruits, vegetables, etc., where this metal occurs naturally. There is often five times as much copper in a pound of wheat as would ever be found in a gallon of water treated for the destruction of algæ. But there is so much evidence in favor of the harmlessness of copper that it is impossible to even refer to it here. After all, it should be borne in mind that it is not a question of an absolutely pure water as compared with water containing a small amount of copper. It is typhoid- or cholera- or algæ-laden water *versus* copper water.

When the efficiency of copper for the destruction of algæ had been fully demonstrated, it became a matter of interest, at least, to determine the effect of this metal upon typhoid, cholera and similar disease germs often conveyed by water. As the result of a large number of experiments we were able to determine that while copper was not quite so toxic to these pathogenic bacteria as to algæ, still the results were sufficiently satisfactory to make it seem probable that, under certain circumstances, the method might prove of considerable value for the rapid and efficient sterilization of large bodies of water.

The conditions governing pollution by algæ and bacteria are, of course, very different. Furthermore, there are methods already in use, which, if properly applied, will remove germs from water, whereas copper is the only means thus far known which accomplishes the desired effect with algæ.

It should be most clearly understood that it was not supposed for a moment that the copper method could be substituted for efficient sand filtration or any other means now in use which has been demonstrated as doing the work thoroughly. It was believed, however, and practical tests since made have proved it, that in cases where no system of filtration existed, or where the filter failed, owing to the storage basin being flooded by surface drainage, or because of leakage or other cause, this method was not efficient, that in copper sulphate we had the only remedy for such emergency cases. It should be borne in mind that nothing is more delicate or requires more intelligent and conscientious supervision than a filter plant. Any one who has had an opportunity to visit many such plants throughout the country and really knowing their inside workings, as it were, can not help being astonished at the low rate of efficiency frequently maintained. Consequently, the application of copper sulphate under such circumstances for the purpose of reducing the bacteriological content has been used successfully in enough cases to demonstrate that it has a distinct place in water purification. Whether it would be efficient and proper to use copper continuously during a considerable period awaiting the completion of a filtration system, is a question to be decided by the conditions governing the case. There is no doubt in my own mind that under certain circumstances such use would be justified, and the results would more than repay any outlay of money and labor.

Others will discuss more particularly the effect of copper upon typhoid, etc., so it is not necessary for me to refer in detail to the work carried on by the department along this line. One other point regarding the effect of copper when used upon a practical scale is of interest, however. That is, that the theoretical strength, or the amount of copper used to destroy algæ and bacteria in the laboratory, is considerably greater than the amount needed on a practical scale. This may be due to the fact that the organisms used in laboratory tests are of necessity more resistant than those occurring under natural conditions; at any rate, results show that where it may require one part in a million of copper to destroy certain algæ under experimental conditions, it only takes one tenth or even less than this amount to accomplish the same result in a reservoir containing millions of gallons of water.

Dr. Henry Kraemer, Philadelphia College of Pharmacy, said: The purification of water supplies containing pathogenic organisms being a subject of such vital importance, it seems to me that any method proposed for this purpose should receive careful consideration, not only at the hands of water engineers, water companies, health officials and physicians, but by all those who are in a position to test the method, or contribute information regarding it, or to foster a sentiment in favor of it if found to be efficient. It was in this spirit that I undertook to test the method proposed by Dr. Moore and Mr. Kellerman.

On account of the false sentiment which had been engendered in Philadelphia with regard to the purification of water by means of copper, and recognizing that the city authorities would not be apt to apply the method so long as there was this prejudice against it, I determined to consider the method in relation to its application for household purposes.

It is, of course, manifestly impracticable for the average householder to use copper sulphate in the purification of drinking water, and my experiments have, therefore, been mostly with metallic copper. I first tried to obtain copper vessels for my experiments, but finding that I should have to wait some time to have these made, those on the market being tin-lined, I decided to use copper foil instead, which perhaps is fortunate, as this is more convenient and less expensive.

In my earlier experiments I had a number of my students in bacteriology carry on the work, using pieces of copper foil about 25 centimeters square to each 2,000 c.c. of water, allowing this to stand from four to eight hours at room temperature, the copper foil being cleansed with pumice for each operation. Agar plates were made and it was found that there was a reduction in the total number of organisms of from 85 to 97 per cent. For some time past one of my special students has been carrying on this work under my direction, and I may say that in all of those experiments where copper has been used the reduction in the number of organisms has been equivalent to what would be obtained by an efficient filtration system, with the advantage in the case of the copper treatment that the organisms are completely destroyed.

In filtration processes it is generally understood that both typhoid and colon organisms are the first to be eliminated, and without waiting to complete a systematic study of the organisms which persist as well as those which are killed in the copper treatment of water, I thought it well to test the method by using water containing these organisms alone.

Inasmuch as results depend in some measure upon the method used, I will try briefly to outline my method before giving my results.

1. Water under three different conditions was employed: (*a*) Distilled water, which was prepared from tap water by first treating it with potassium permanganate and then distilling it two or three times by means of apparatus constructed entirely of glass. (*b*) Filtered tap water, prepared by means of a Berkefeld filter attached to a copper spigot. (*c*) Tap water collected after being allowed to run through a copper spigot for five minutes. All of these were sterilized in an autoclave at 110 degrees for thirty minutes.

2. The cultures of typhoid and colon which were used were pure cultures developed in bouillon for eighteen to twenty-four hours.

3. To 200 c.c. samples of water prepared as above, and contained in sterile Erlenmeyer flasks, were added two three-millimeter loops of the fresh bouillon cultures of typhoid and colon bacilli, respectively. Counting the duplicate experiments provided for, we thus had a series of twelve flasks, six of them containing typhoid bacilli, and six colon bacilli.

4. For studying the number of organisms 1 c.c. of the respective solutions was transferred directly to a Petri dish by means of a sterile 1 c.c. pipette, and to this was added 10 c.c. of Heyden's nutrient agar which had been kept at a temperature of 40° C. for some time. Three separate plates of the water in each of the twelve flasks were made immediately upon the addition of the cultures, and both the plates and the flasks were kept at a temperature of 35°–37° C. To six of the flasks were then added strips of copper foil about 15 mm. wide and 18 cm. long, these being corrugated in such a manner that the entire surface was exposed to the water.

5. Plates were made from all the twelve flasks at the end of four and eight hours, and one, two and six days, even in the cases where no organisms remained, and in the cases where they continued to develop, at the end of fourteen, twenty-one and twenty-eight days. The results are given in the following tables:

TABLE I. EXPERIMENTS WITH BACILLUS COLI.

	Water *without* Copper Foil.		
	Triple Distilled Water.	Filtered Tap Water.	Tap Water.
Plates made at time of adding culture...	7,746	11,246	8,283
Plates made at end of four hours............	7,655	5,075	7,665
Plates made at end of eight hours..........	7,735	3,115	7,000
Plates made at end of twenty-four hours...	1,000,000	1,000,000	1,500,000
Plates made at end of forty-eight hours...	1,200,000	1,600,000	2,000,000
Plates made at end of 6 days..................	1,200,000	1,000,000	1,200,000
Plates made at end of 14 days................	1,060,000	910,000	2,245,000
Plates made at end of 21 days................	700,000	462,000	650,000
Plates made at end of 28 days...	700,600	462,466	649,666
Plates made at end of 53 days................	602,000	456,000	693,000

	Water *with* Copper Foil.		
	Triple Distilled Water.	Filtered Water.	Tap Water.
Plates made at time of adding culture...	8,866	4,410	6,790
Plates made at end of four hours............	No organisms.	No organisms.	No organisms.
Plates made at end of eight hours..........	"	"	"
Plates made at end of twenty-four hours...	"	"	"
Plates made at end of forty-eight hours...	"	"	"
Plates made at end of 6 days.........	"	"	"
Plates made at end of 14 days................	"	"	"
Plates made at end of 21 days................	"	"	"
Plates made at end of 28 days................	"	"	"
Plates made at end of 53 days................	"	"	"

I may say that every single experiment which we have conducted, not only those given in the foregoing tables, but all others, shows that copper foil is exceedingly toxic to colon and typhoid bacilli, particularly the latter.

* Bowlton cultures of the different samples of water gave at the end of sixty days with Widal's test the characteristic behavior of typhoid organisms.

TABLE II. EXPERIMENTS WITH BACILLUS TYPHOSUS.

	Water *without* Copper Foil.		
	Triple Distilled Water.	Filtered Tap Water.	Tap Water.
Plates made at time of adding culture...	3,740	4,750	3,675
Plates made at end of four hours............	2,835	No organisms.	3,815
Plates made at end of eight hours...........	3,850	"	1,995
Plates made at end of twenty-four hours..	3,750	"	1,435
Plates made at end of forty-eight hours...	3,815	"	1,540
Plates made at end of 6 days..................	1,850	"	—
Plates made at end of 14 days................	16,380	—	3,920
Plates made at end of 21 days................	39,690	—	65,500
Plates made at end of 28 days................	153,600	—	221,867
Plates made at end of 60 days................			

	Water *with* Copper Foil.		
	Triple Distilled Water.	Filtered Water.	Tap Water.
Plates made at time of adding culture...	3,986	127	1,400
Plates made at end of four hours............	No organisms.	No organisms.	No organisms.
Plates made at end of eight hours...........	"	"	"
Plates made at end of twenty-four hours...	"	"	"
Plates made at end of forty-eight hours....	"	"	"
Plates made at end of 6 days..................	"	"	"
Plates made at end of 14 days................	"	"	"
Plates made at end of 21 days................	"	"	"
Plates made at end of 28 days................	"	"	"
Plates made at end of 60 days................	"	"	"

It will be seen by consulting the table that in the filtered water to which no copper foil had been added, the typhoid organisms did not grow and multiply as was the case with the tap water and distilled water, although there were a larger number of organisms to begin with. This also applies in a measure to the colon bacilli, where there is a very marked inhibiting action in those growing in filtered water.

At first I was inclined to attribute this to minute traces of copper in the flasks, but subsequent experiments showed that this was not the cause of the diminution of the organisms. I am, therefore, inclined to attribute these rather anomalous results to the presence of extremely small quantities of copper dissolved by the water in its necessarily slow passage through the copper spigot to which the filter was attached.

Some time ago I was asked if I thought that a copper plate placed at the intake of a reservoir would be effective in destroying typhoid organisms. At that time I felt such a result was almost too marvelous to be within the range of probability. But in view of the results which I have just given it seems that copper exerts a marked oligodynamic action on typhoid and other intestinal organisms, although this action is not so marked as in the case of algæ and some of the saprophytic fungi.

It is extremely fortunate that in the copper treatment of water, a method has been devised which is so effective in destroying intestinal microorganisms and which can be applied so easily on a large scale and so safely even in the average household. Of course the proper place to purify the water supply of a city is in the reservoirs, before the water reaches the consumer, as thus the distribution of organisms like typhoid is brought within the narrowest limit, and individual carelessness in the community is overcome.

In a city like Philadelphia, which depends for its water supply upon a river which has tributaries in the coal region and subject to contamination of all kinds, including sewage and waste products from manufacturing establishments, it is, of course, very necessary that the water be freed from gross impurities by sedimentation and filtration.

At time of freshets the amount of suspended matter may be as much as 500 parts per million and it is not unusual to see a statement like the following in the daily papers:

> Philadelphia is to receive another dose of the inky water from the coal regions of Pennsylvania. Already the water is of a yellowish-red color, and by to-morrow the coal dust residue is expected. The rains in the Schuylkill valley are responsible, the deposits from the culm piles about the mines being washed into the tributaries of the Schuylkill River and into the main stream as well.

But even in Philadelphia, where the necessity for a filtration system is so urgent, there are times when the application of a method like the one proposed by Dr. Moore would be highly advantageous. I may cite two examples in this connection:

1. Only last September a certain section of Philadelphia required 28,000,000 gallons of water, and the filters for that section delivered only 22,000,000 gallons, and in order to provide the necessary supply 6,000,000 gallons of unfiltered water were added. This deliberate 'repollution' of the water supply, as it was termed by Director Martin, of the Department of Public Health, could readily have been corrected by the use of the copper method of purification.

2. Some years ago while flushing one of the large sewers, by an unfortunate accident there was an overflow at a point along the Schuylkill River just above one of the pumping stations, and as a result of this contamination of the water supplied to that section of the city there were 258 cases of typhoid fever in this section in two weeks afterward, and nearly 1,500 cases within the next two months.

Instances could be multiplied where the copper method of purification of water could be applied as an emergency method, if not regularly in connection with filtration.

Even granting the efficiency of the boiling of water for domestic purposes, I believe that the copper-treated water is more natural and more healthful, inasmuch as the various inorganic constituents, particularly the salts of calcium and magnesium, are in a more soluble and assimilable condition, being furthermore less concentrated, at the same time the natural gases of the water being retained.

From the experiments thus far conducted the following conclusions may be drawn:

1. The intestinal bacteria, like colon and typhoid, are completely destroyed by placing clear copper foil in the water containing them.

2. The effects of colloidal copper and copper sulphate in the purification of drinking water are in a quantitative sense much like filtration, only the organisms are completely destroyed.

3. Pending the introduction of the copper treatment of water on a large scale the householder may avail himself of a method for the purification of drinking water by the use of strips of copper foil about three and a half inches square to each quart of water, this being allowed to stand overnight, or from six to eight hours, at the ordinary temperature, and then drawn off or the copper removed.

Dr. Mary E. Pennington, bacteriologist, Department of Public Health, Philadelphia, said: In the city of Philadelphia, work on an extensive sand filtration system is being pushed just as rapidly as possible. Portions of the city are now being supplied with filtered water and in the course of a few years such water will be distributed over its entire area. Until this time arrives there will, almost certainly, be outbreaks of typhoid fever of greater or less severity and extent. The problem of an efficient, wholesome and rapid purification of water, primarily for the general city supply, secondarily for use in the household, is, therefore, temporarily but emphatically, before the health authorities of Philadelphia. Any method which offers a possibility of success must be carefully weighed by them.

Among the methods considered by the city and worked upon in its laboratories is that of the purification of water by copper, either in the form of salts or as metal, the aim being to eliminate typhoid and colon bacilli.

Dr. Stewart, working from the standpoint of household purification more especially, has had constructed copper vessels of varying sizes in which he has placed typhoid germs suspended in distilled water, sterile filtered water and raw river water. In very clean, brightly polished copper vessels the organisms of typhoid fever were soon killed, sometimes in less than two hours, and the common river water germs were considerably reduced in number, but never exterminated. In glass or tin, on the contrary, all the organisms showed a decided increase.

The city laboratory has also conducted some experiments to determine the germicidal efficiency of copper plates charged with very low electric currents—less than 4 volts and 0.01 ampère—over which the water to be purified was allowed to flow.

The suspension of copper electrodes in water which is not agitated causes a more rapid reduction in the number of organisms than is accomplished by copper without the current. When, however, the apparatus is arranged to simulate a reservoir, with inlet and outlet and of such construction that the entering polluted water must come into intimate contact with several electrified copper surfaces, the reduction in the number of both typhoid and colon bacilli is very great almost immediately. When such an effluent has stood at room temperature for an hour it is practically sterile.

The copper, too, which, when germ-free water is used, may be found in traces, is, apparently, entirely eliminated from water containing a large number of organisms.

Unfortunately, these experiments have been confined to laboratory quantities and conditions. It is hoped that an opportunity will offer to try them on a larger scale.

Mr. Alfred M. Quick, chief engineer, Baltimore Water Department, said: The subject under consideration here to-night involves so much more of chemistry, bacteriology and entomology than it does of water-works engineering, with which I am more familiar than I am with the sciences I have referred to, that I would very much prefer to have appeared here simply in the rôle of listener.

I have been very much interested in the extremely valuable discussion of this subject from the scientific standpoint of all the previous speakers. The only excuse for my speaking or appearing here in any other rôle than as a listener is, I suppose, because I have had some experience in the practical application of copper sulphate in the treatment of large reservoirs in use in a water department.

As to the experiments that we made, while they were probably not so valuable in illustrating the success of this method of treatment as some other cases where the proportion of algæ in the reservoir was very much greater than it was in our case, or where the trouble had been experienced from the presence of these organisms for a longer time than it has been in Baltimore, still they give results that are none the less emphatic and conclusive. As I have said, we have not had any trouble with these organisms for any long period, and we had no reason to suppose that they are present in any large quantity in our reservoirs. We have had trouble, however, with complaints of bad water, water of bad odor, bad taste and discolored water, but in every case—practically every case—we have been able to get rid of the complaint by flushing the mains, our conclusion being that the trouble was caused by the numerous dead ends in the distribution system and also by bad management of previous years in allowing muddy water to be sent to the city and thus filling our water mains with sediment.

As I say, we had been able to get rid of these complaints in previous years by flushing the pipes, but this past summer there was a continual complaint by a large artificial ice manufacturing concern that the ice had a bluish-green color which practically made it unmarketable. Supposing that the cause was the same as in the most of the previous cases, we started to flushing the pipes and connecting up some dead ends in that vicinity, hoping by that means to get rid of the complaint, but it still continued. I, therefore, made a personal examination of the matter and found that the ice was badly discolored and that there was apparently no evidence of sediment in the water, so that the complaint was undoubtedly due to the presence of some vegetable organisms in the water. It immediately occurred to me to try Dr. Moore's suggested method of treating the water in reservoirs to eliminate the algæ by the application of copper sulphate.

I had read his pamphlet and was convinced of the value of the method of treatment which he suggested, and so I communicated with Dr. Moore, and he sent his assistant, Mr. Kellerman, over to Baltimore and he examined the water in the reservoirs, Lakes Clifton and Montebello, which feed the district from which the complaints came. He also made some analyses of samples of the water in these lakes, which showed that the particular species of algæ which cause the disagreeable odor and discoloration, and other species, were present in such considerable numbers as to justify an experiment with the copper sulphate.

However, before attempting to make such an experiment, not because I had any doubt as to the merits of Dr. Moore's suggested method or as to its leaving the water absolutely safe for potable purposes, but because, holding a political position, it was well to fortify myself before attempting anything unusual, I, therefore, communicated with all the leading chemists of the city, particularly the chemists in the health department, and one other gentleman, whose name I am not at liberty to mention, but who is probably one of the three or four greatest biological chemists in this country, and had them all committed beforehand—not as agreeing that the experiment would be a successful one in eliminating the algæ, but as emphatically agreeing that if the method Dr. Moore had suggested was adopted, there would be absolutely no danger to any consumer in drinking the water.

So we proceeded to put the copper sulphate in the two large reservoirs, using our own employees for the purpose. For Lake Clifton 300 pounds of sulphate was used, or about one part to 6,390,000 by weight. The method of application was as follows: The lake was first shut off entirely, both at the inlet and outlet. The sulphate was in four bags of 75 pounds each. One bag at a time was suspended from the stern of a rowboat, and as soon as it was about three quarters dissolved another bag was put out. The boat was rowed around the lake in concentric courses about 40 or 50 feet apart, and at such a rate as to cover the lake completely by the time the four bags of sulphate were dissolved. It took 128 minutes to dissolve the 300 pounds applied. A sample of the water was taken near the center of the lake just previous to the application of the sulphate and samples were taken at the same place in the lake at intervals of 24 hours after the application. These samples were for biological analyses. Samples of the lake water were also taken in sterilized bottles, both before and after application of the sulphate, for bacteriological analyses.

The biological analyses indicate a very great reduction in the number of algæ in the first 48 hours after treatment, and practically a complete elimination of algæ in 120 hours. On account of rain falling in the reservoir during treatment, unfortunately the bacteriological analyses give no correct indication of the action of the sulphate on the bacteria in the lake. These analyses were all made by Dr. Wm. R. Stokes, the city bacteriologist. An analysis of the samples was also made by the city chemist to determine the proportion of copper present, and no trace of copper was found in the water as early as 24 hours after application of the sulphate.

The method of treatment of Lake Montebello was exactly the same as at Lake Clifton, except that a larger amount of copper sulphate was used; 600 pounds were applied, or about one part in 6,685,800 by weight. As with Lake Clifton, the analyses showed a very considerable reduction in the number of algæ in 48 hours after application of the sulphate, but the analyses of samples taken at intervals of 24 hours thereafter showed a slight increase in the number of algæ until the eighth day after treatment, when the number per cubic centimeter dropped to 14. At that time it was found necessary to turn Lake Montebello into consumption, and therefore no further analyses were made. It is possible that if the examination had been continued we should have found the algæ practically eliminated, the same as at Lake Clifton.

A chemical analysis showed no trace of copper in the water five days after application of the sulphate.

We had no bacteriological analyses made of the water in Lake Montebello because our experience with Lake Clifton tended to substantiate the intimation by Dr. Moore that the proportion of copper sulphate which we used would be too weak to have much, if any, effect in reducing bacteria.

So much for the results shown by the analyses. The practical value of the treatment was observed in the very great diminution in the number of complaints of bad water, which had been unusually large just previous to the experiment.

The cost of the experiment was between $60 and $70, which was for the copper sulphate used, or less than ten cents per million gallons treated.

Dr. C. L. Marlatt, entomologist, Bureau of Entomology, said: In the original publication on the use of copper sulphate against algæ, a paragraph was given indicating the results of certain incidental experiments with mosquito larvæ. These experiments indicated that a strength of 1 to 40,000 was apparently necessary to kill presumably nearly full-grown larvæ. The strength indicated is greater than is practicable for water to be used for domestic purposes, but a distinct toxicity of the copper sulphate for mosquito larvæ was shown. A series of experiments was immediately instituted in the laboratory of the bureau to determine the exact value of copper sulphate in this field. The common method of destroying mosquito larvæ in comparatively still bodies of water is in the use of kerosene oil. This, however, has the objection of rendering the water unpalatable, and the copper salt seemed to offer a possibility of the use of a substance which would not injure water for domestic consumption.

During the spring and summer of 1904 more than 75 experiments were made with copper sulphate, beginning with the first larvæ available in the spring, and continuing until autumn. Tests were made with various kinds of water, namely, distilled water, hydrant water, foul water from old rain-water barrels of long standing, and water from outdoor ponds more or less soiled with earthy matter and animal and vegetable life. The mosquito larvæ subjected to the different tests were various species of *Culex* and *Anopheles;* the former the common biting mosquito, and the latter representing the species responsible for the conveyance of malaria.

The importance of the water conditions was at once evident. The copper sulphate showed very considerable effectiveness in comparatively pure water, and lost its action very quickly in foul water or water containing much earthy matter, in the latter cases the copper being quickly precipitated with the foreign matter in the water. The use of distilled water and comparatively pure hydrant water was of value in determining the direct toxicity of copper sulphate; in other words, in such water the killing of the larvæ could not be charged to the destruction of the food in the water, which might reasonably be offered as the explanation in the case of more or less foul water in which mosquitoes ordinarily breed, containing quantities of vegetable and animal life. Mosquito larvæ were killed in distilled and pure hydrant water quickly, and in the check jars in which no poison was placed they remained in healthy condition indefinitely, or at least exceeding a week or ten days.

The larval conditions also exerted a very marked influence on the results. The young larvæ are killed with minute additions of copper sulphate. The strength necessary to effect the prompt death of the larvæ increases very quickly with the age of the larvæ. In comparatively pure water, such as hydrant water, a strength of from 1 to 100,000 to 1 to 5,000,000 killed newly hatched larvæ with promptness, that is, within 24 to 48 hours. Any strength of copper sulphate between 1 to 100,000 and upwards is stated to be a practicable strength for use in water for domestic purposes. One to 500,000 was almost as effective as

1 to 100,000, and is probably as high a strength as need be used for killing newly hatched larvæ in clear water. In the case of half or two thirds grown larvæ the immediate death of the larvæ was not secured, but they were held in arrested development for several days and slowly perished, some few surviving two weeks, and this at strengths between 1 to 100,000 and 1 to 500,000. The effect on full-grown and nearly full-grown larvæ is to hasten their transformation to the pupal stage, such larvæ transforming within a few hours to one day after the application of the copper sulphate. Once in the pupal stage, no practicable strength of copper sulphate is effective against them. Strengths as great as 1 to 1,000 were employed, and the pupæ so treated were seemingly completely immune from its effect, and ultimately transformed to adult insects. The reason for the almost absolute immunity of the pupal stage is probably because in this stage no food is taken, and the poison is purely external and has no opportunity to act.

It was further shown that copper foil was very effective in destroying newly hatched larvæ. A piece of copper foil less than six inches square killed, in two quarts of water, the majority of young larvæ within 24 hours, and all within 48 hours. The possibility of using copper foil, therefore, to keep mosquito larvæ out of small bodies of comparatively pure water is shown. In all of these tests check experiments, without the addition of copper, were carried out.

The general results shown are that newly hatched mosquito larvæ are killed in comparatively pure water by practicable additions of copper sulphate, namely, between 1 to 100,000 and 1 to 5,000,000, the necessary strength varying with the purity of the water; that copper foil exerts a remarkable effect upon young larvæ; that the very highest practicable strength, namely, 1 to 100,000, will check the development of half and two thirds grown larvæ, and cause their ultimate death; that nearly full-grown and full-grown larvæ are induced to promptly pupate, and that in the pupal stage absolute immunity to copper salts is shown.

The practical application of copper sulphate seems, therefore, limited to the protection of small bodies of comparatively pure water. It is further possible that in the tropical countries, where much of the drinking water is kept in cisterns, it will have a distinct field for usefulness, and possibly particularly against the yellow-fever mosquito. Field tests in open ponds failed to show any special value for copper sulphate; it seemed to be precipitated too quickly to have any important effect on the larvæ. The value of copper sulphate against mosquitoes needs for its demonstration further tests, and particularly under the tropical conditions referred to.

Dr. H. W. Wiley, chief chemist, Bureau of Chemistry, said: In regard to the use of copper for purifying water, I have nothing whatever to say except as it may pertain to water as a food. It is recognized by all physiological chemists that water is one of the principal foods and one of the most necessary. The act of Congress authorizing the investigation by the Bureau of Chemistry of the adulteration of foods includes beverages in the list of the articles to be studied. The whole matter, therefore, of the addition of copper to water which is to be used for food purposes is intimately related to other problems of a similar nature which we have had under study in the Bureau of Chemistry for the past twenty years. There are two ways of considering the evidence which has been accumulated on this subject. One is to consider the addition of certain substances, copper sulphate among them, to foods, as a process involving the use of harmless substances; the other view is to regard the substances themselves as harmful. In the latter case there must be an abundant justification on the part of the user to excuse their introduction. I think we may assume, for the purposes of this argument, that copper sulphate is in itself an injurious substance. This does not relate to its use in a medicinal sense. It is well known that the great majority of drugs which are used in disease are not harmless to health; in other words, the fact that any given substance may be used as a remedy in disease is no justification whatever for its use by persons in health.

The fact that a substance may be naturally found in a food product accidentally or otherwise, which in itself is harmful, is no excuse for adding more of the substance to the food product. For instance, hydrocyanic acid is found in certain food products, such as peaches and cassava; borax is found almost uniformly in grapes and wines; benzoic acid occurs in considerable quantities in cranberries, and copper is occasionally found in some food products in weighable quantities. It requires no argument to show that the accidental presence of bodies of this kind is no justification whatever for adding additional quantities thereto. In other words, foods themselves are often injurious, but that does not imply that more injurious substances should be added to them. The attitude of experts in regard to these matters is the most puzzling problem of all. Men of equal honesty, equal ability and with equal skill as experimenters entertain diametrically opposed views on these subjects. It appears that the one safe position each layman can take in the matter is to demand protection from being compelled, without his knowledge, or even with his knowledge, to consume substances in foods which a very respectable part, or perhaps even a majority of expert evidence, condemns. The right of any one to consume antiseptics and coloring matters in his food should not be denied, but it is not fair that those who hold a contrary opinion should find it almost impossible to secure food products devoid of the substances to which he objects. This principle, it appears to me, applies particularly to water, which is a substance of universal consumption. The principal excuse for the use of a substance like sulphate of copper, aside from the effect which it has on the living organisms in the water, is found in the statements which have been made that no copper remains in the water. Any residual quantity remaining, be it ever so small, is objectionable. The argument *de minimis* is in my opinion wholly fallacious.

A very full discussion of the subject of the presence of copper in foods is found in the report of the committee on food preservatives, presented to both Houses of Parliament by command of the King in 1901. The report was signed by Herbert Maxwell, chairman, T. E. Thorpe, H. Timbrell Bulstrode and F. W. Tunnicliffe. On page xxx, article 136 of this report, section F, under recommendations, it is stated 'That the use of copper sulphate in the so-called greening of preserved foods be prohibited.' This part of the report, it is but fair to say, was not concurred in by Mr. Tunnicliffe. After stating his reasons for not signing the recommendation as given, he states, page xxii: "I am, however, satisfied that often an unnecessarily large amount of copper is present in vegetables permanently colored by means of it, and although in spite of diligent investigation no injurious results have been known to have occurred even from these quantities, yet, nevertheless, only the necessary amount should be added. I should, therefore, recommend that the presence of copper in these preserved vegetables be in every case declared and that its amount be restricted to one half grain of metallic copper per pound.''

If it be proved that copper sulphate is a preservative by reason of its germicidal character, then it falls under the general rule of preservative substances.

In this case the findings of the International Congress of Hygiene and Demography which met at Brussels in September, 1903, would apply. The third resolution adopted by that congress in the section of alimentary hygiene is as follows: 'The employment of antiseptics should be prohibited in the preservation of alimentary substances.'

Rideal states in his recent work, entitled 'Disinfection and Preservation of Food,' on page 156, that the soluble salts of copper have a distinct poisonous action on bacteria. The coagulated albumen combines with most of the organic acids present to form non-putrescible salts. They absorb sulphur, hydrogen, ammonia and compound ammonias and, therefore, combine with ptomaines. In fact, copper salts rank next to mercury in power as antiseptics. Kroncke proposed a method for purifying water with copper salts in volume 36 of the *Journal für Gasbeleuchtung*, page 513. He used cuprous chloride in connection with ferrous sulphate, and, finally adding a small quantity of lime, succeeded in entirely removing any residual copper. In 1892 the French authorities decided to adopt as their official disinfectant in combating cholera sulphate of copper.

These few illustrations are given out of many hundreds which might be cited to show that in general the opinion of experts regarding the presence of copper in food is decidedly unfavorable. To state particularly my attitude respecting the use of copper in water, it appears that, in the first place, only bad water needs treatment, just as only bad milk needs to be pasteurized or sterilized. I think that it is the general opinion among physicians, hygienists and physiological chemists that the pasteurization or the sterilization of milk is distinctly prejudicial to the digestive processes and should only be practised where greater dangers, namely, those arising from infected milk, are to be feared. This principle, it seems to me, applies also to water. There is practically no such thing as pure water available for consumption. Water is the scavenger of nature and tends to dissolve or carry away mechanically all kinds of refuse matter. Every spring and stream is only a sewer. Nature, however, provides means for at least partial purification. These means are found in the germs which water contains. The activity of such germs is beautifully shown in the processes which take place in the septic tank. A polluted stream, and every stream is more or less polluted, is only a septic tank of a different character, and the reservoirs which hold the waters which supply our cities are also septic tanks. To add to water in a reservoir or other container a chemical reagent which paralyzes germ activity by coagulating the protoplasm, or in other ways, renders waters powerless for self-purification. There is also another point to be kept in view, namely, the possible relaxation in care in controlling the water supplies by the use of a sterilizing agent. Just as the milk dealer may fail to wash his cans or keep his cows clean, if he uses formaldehyde, so the officials of a city in charge of the water supply may fail to care for or supervise the purification of the water sources if a cheap and efficient sterilizing agent can be employed. It appears, therefore, that in most cases a sufficiently pure water supply can be secured without the aid of a sterilizing agent. If, however, a sterilizing agent is to be used, there are great difficulties connected with its control and the universal tendency in such cases is always to use it in excess. This has been illustrated so thoroughly in the case of antiseptics in foods that it needs no further elaboration. If water for potable purposes is sterilized with sulphate of copper the actual quantity necessary could only be determined by most careful observation at each time the reagent is used. If too little is used the object is not secured. If too much, the excess remains in the water. Copper is nearly related to those metallic substances which produce cumulative effects in the system, such as arsenic, mercury and lead. Careful physiological researches have shown that minute quantities of copper long ingested produce great disturbances, especially in the liver. It should be the object, then, of the health officer to furnish water as pure as possible, and, if sterilization is necessary, to have it accomplished by means which are not likely to introduce harmful substances. There appear to be two unobjectionable processes capable of being used, one the application of heat and the other ozone.

In fact, in view of the well-known properties of copper and its salts in relation to electricity, the query may arise whether the germicidal effects which have been proved to ensue from the introduction of metallic copper into ordinary drinking water may not possibly be related to the production of ozone. Dr. Kraemer has conclusively shown the germicidal properties of copper when placed in ordinary water. These properties must arise either from a solution of the copper itself or from the electrical activity developed, including, possibly, the production of ozone. If the germicidal properties are due to the solution of the copper, then there is always danger of excessive copper going into solution, thus rendering the use of such water objectionable.

One point which has been brought out by the papers read to-night is worthy of careful consideration, namely, that copper sulphate may be used in quantities sufficient at least to kill algæ without leaving any excess of the copper in the water. If copper salts can also be used in sufficient quantities to kill pathogenic germs and the residual excess of copper be entirely precipitated thereafter, the principal objection to the indiscriminate use of copper in water would be removed. At any rate, it seems to me that it would be preferable during times of epidemic, especially, to drink water with a little excess of copper, rather than to drink water containing the germs of typhoid fever.

The question is one of great interest from many points of view, and my particular purpose in speaking to-night is to say a word of caution against the use of chemical germicides and antiseptics which may themselves be sources of contamination.

Copper sulphate is known to be one of the strongest disinfectants and was adopted as long ago as 1892 as the official disinfectant against cholera by the French authorities. Disinfectants have their uses, as we all know, but they should, if possible, be kept out of foods, especially in cases where there is no danger of epidemics.

Mr. M. O. Leighton, hydrographer, Division of Hydroeconomics, U. S. Geological Survey, said: The application of copper sulphate to storage reservoirs for the purpose of destroying algæ has been quite thoroughly investigated by several men of good standing and it has received sincere endorsement. I have not, however, until to-night, heard any detailed statements concerning actual experiments upon its bactericidal properties. Until the investigation of Dr. Moore was made public, I had always been of the opinion that copper sulphate was an excellent disinfectant when used in solutions of a comparatively high concentration, and in fact during a period in which I was engaged in public health work I made extensive use of such solutions in drains, vaults and infected places where crude methods were ineffective. That it is highly toxic in so extremely dilute solutions seems almost beyond belief, yet the experiments outlined by the speakers successfully bear all the scrutiny which I have been able to give them and seem to substantiate all conclusions drawn from them.

In connection with the application of copper sulphate to storage reservoirs for the purpose of destroying algæ, the possibility of rendering such organisms more resistant to the toxic effects of this substance suggests itself. Organisms of this low type readily adapt themselves to environment and it is a common observation among bacteriologists that an organism can be made immune against the toxic effects of an amount of substance which under ordinary conditions would prove fatal to it. This can be readily accomplished in the laboratory by applying to such organisms a subtoxic amount of germicide, and if the experiment is repeated several times the resistance of the organisms to that substance can be raised to a surprising degree.

In discussing certain objections to the use of copper sulphate in public water supplies, Dr. Wiley has justly observed that the zeal of certain poorly informed water superintendents will lead them to apply more copper sulphate to the water than is necessary for the purposes in view, and thereby possibly increase the amount contained in the water to a point at which it would have an unfavorable effect upon the consumers of that water. The reverse of this is also true. It is no easy matter in many cases to determine the amount of water contained in a reservoir or pond, and even the most careful measurements will vary occasionally by fifty and sometimes even one hundred per cent. Now if a water superintendent like that mentioned by Dr. Wiley should determine in his customary arbitrary fashion the amount of water in a reservoir and apply to it a proportion of copper sulphate, based upon his incorrect estimate of the contents of the reservoir, either more or less than is absolutely necessary will be used, according to the error in the estimate. Every time an insufficient amount is applied it will undoubtedly have the effect of raising the resistance of the algæ to this germicide and there will come a time when it will be impossible to exterminate them without the addition of a prohibitive amount of the sulphate.

Dr. Moore assumes that by the addition of a proper amount of copper sulphate the algæ will be driven from a reservoir for all time and states that up to the present time in no case has the organism been found to persist. There is, however, a notable case in which a second application has been necessary. The work was carried on by one of the foremost water biologists of the United States who has given long years of study to the microorganisms which give offense in public supply. In this case the operator possessed an accurate knowledge of the amount of water in the reservoir. The water was infested with the organism '*Anabæna*.' One application conducted according to Dr. Moore's directions failed to exterminate the organism and a second treatment was applied which was effectual. Almost immediately, however, the organism '*Chlamydomonas*,' which is in some respects far more objectionable, developed in the reservoir, flourishing apparently upon the '*Anabæna*' debris, the result being that the conditions were far worse than those which existed previous to the first application of copper sulphate. This experiment indicates that one application is not always effectual and that an amount of copper sulphate toxic for an ordinary alga may not destroy the more uncommon varieties.

These observations are cited merely for suggestion. They do not by any means dispute the value of the highly successful work which has been described by the previous speakers, nor do they detract in any important degree from the usefulness of this discovery. They are presented merely to show that copper sulphate must be used with discretion, and like all other good things it may fail at critical times.

Dr. A. H. Doty, health officer, port of New York, said: As the result of my own investigations with sulphate of copper, I am convinced of its value in sanitation, particularly as a deodorant and for the clarification of water when used either alone or in combination with lime. So far as its germicidal value is concerned, I do not believe that at present we are in possession of sufficient data to present definite and satisfactory information on the subject. Tests which have already been made at the New York State Quarantine Laboratory with the typhoid and cholera organisms in distilled water, tap water, contents of street sewers and broth indicate that the germicidal value of this agent may equal our expectations. I have been interested in Dr. Moore's valuable publication relative to the purification of reservoir water by copper sulphate. During the past summer I witnessed practical demonstrations of the value of this agent in the direction just referred to, and have recently suggested the use of it in a small reservoir in the western part of New York, where the water was so offensive by the reason of a fishy odor and taste that it could hardly be used for drinking purposes. The report of the health officer who had the matter in charge leaves no room for doubt as to the successful result. Within a few days after the introduction of the copper in accordance with Dr. Moore's suggestion, the offensive odor and taste of the water had disappeared and since that period there have been no further complaints. In experiments which were made during the past summer with water containing mosquito larvæ taken from pools in districts where this insect was actively propagated and placed in large wooden tanks, I found that the copper alone and in combination with lime promptly deodorized and clarified the contents of these receptacles even when large amounts of decomposed organic matter were added. However, in these instances more copper was used, usually from five to twelve grains for each gallon of water experimented with. Even with this amount,—chemical examination at the end of twenty-four hours failed to detect the presence of copper in the clarified water. I am satisfied that Dr. Moore's suggestions as to the use of copper in small amounts for the destruction of algæ, and for removing the offensive odor and taste which frequently occur in reservoirs, is safe, practical, economical and very effective. However, I am unable to endorse the recommendation made by Dr. Moore as to the use of sulphate of copper as a disinfectant in reservoirs presumed to contain pathogenic organisms, particularly the typhoid bacilli. As a result of a sudden and formidable outbreak of typhoid fever in a community, and in the absence of some known cause, we are justified in assuming that the water supply, if a common one, is the medium of infection, although we rarely have positive proof of this as a result of bacteriological examinations. There are but few instances where the organism has been detected in drinking water. Therefore, if present we can not as a rule determine when they disappear. In this there is a great difference between the satisfactory results obtained in laboratory experiments where we know that the bacilli are present, and know when they are destroyed. Furthermore, in treating the contents of a reservoir we are dealing with factors which are not present in experimental work. For instance, the uncertainty as to the exact character of the media which presumably contain the organism. Reservoirs are constantly receiving water which is not always of a certain standard; besides, the organic matter also varies in amount. This alone would tend to throw doubt on the value of sulphate of copper in the disinfection of reservoir water, notwithstanding the argument that the water may be frequently tested to ascertain its contents. It must be remembered that we have before us for consideration the use of copper in exceedingly minute amounts which may be easily neutralized and rendered useless by different constituents of the water.

As a matter of fact, the disinfection of reservoir water on the occurrence of an outbreak of typhoid fever is not the most important consideration. Our first duty should be to ascertain the origin of infection, which is not in the reservoir itself, but in some way connected with the reservoir supply. The most exhaustive inspection is frequently required to discover this contamination, as it is commonly due to mild or ambulant cases of typhoid fever which have escaped detection or have been mistaken for some other disease. Until we have accurately determined the origin of infection or have used every effort to do so, and if possible have isolated the cases, have performed and maintained thorough disinfection at the seat of infection, we have not properly performed our duties as public health officials. In these instances other means of preventing the extension of typhoid fever must of course be employed. The character of these depends somewhat on the conditions present in each outbreak, and it is likely that in this connection the sulphate of copper can be used advantageously. Whatever future investigation may disclose as to the value of this agent as a disinfectant, I am certain that our present knowledge of it does not justify us in depending upon it in outbreaks of typhoid fever to the extent recommended by Dr. Moore.

Dr. Moore said: In concluding this discussion it does not seem necessary to make any further reference to the efficiency of copper sulphate and metallic copper. That it really does all that is claimed for it at tremendously high dilutions seems to have been abundantly demonstrated both by laboratory experiments of independent workers and by its use in a practical way upon a large scale.

The one point about which there is naturally the most question is the effect of copper upon the human system. It is difficult for any of us to abandon any prejudice, whether it has any foundation in fact or not, and to expect a universal acceptance of the use of a metal which for years has been looked upon with fear and distrust in this country is out of the question.

However, since there has been such a unanimous expression of opinion from all the speakers that they would unquestionably prefer a copper-treated water to one containing algæ or typhoid or cholera germs, it seems that it may be worth while to use the few moments at my disposal in an attempt to point out some of the facts that are well known regarding the effect of copper upon man. For, contrary to the idea of some, we have a very large accumulation of facts along this line, as the result of experiment upon the lower animals as well as man.

Certainly, the argument that our daily food naturally contains comparatively large amounts of copper is not one in favor of using the same substance in any quantity for the purpose of adulteration or sophistication. Nor was it intended that a reference to this fact should be so interpreted. The only point that it seemed desirable to make was that since we had such a tremendous amount of practical evidence, all tending to demonstrate the harmlessness of copper, that it could not be the dangerous poison popularly supposed. No amount of theoretical evidence regarding the innocuousness of a substance will convince the man who has been made violently ill by eating it, and so, on the other hand, the fact that we have all been consuming copper for years without any known deleterious effect is to the average mind a point in favor of the harmlessness of minute quantities used for specific remedial purposes. The situation is well illustrated by the action of the English judge who had listened to the conflicting evidence of experts in a case regarding the use of copper for greening peas until he could tell nothing whatever about it. Finally he discovered that the brand of peas under discussion had been upon the market for thirty-six years, and there were now sold some 20,000,000 cans per year. He then asked the prosecution to produce evidence of a single instance of sickness or injury which in the remotest way could be traced to these vegetables, and as this could not be done, he considered the evidence of experience so great as to warrant dismissing the case.

Coming directly to the results of experiments designed to show the effect of copper upon man, I can refer in only the briefest way to the large mass of evidence accumulated along this line. For fourteen months Gallipe and his family used food containing amounts of copper easily determined, without any noticeable effect. Kobart's experiments show that an average man can take 1 gram of copper per day with perfect safety. This is a thousand times more than could be obtained from water treated with copper sulphate. Lehmann, Burcq and many other careful investigators have demonstrated that the ingestion of copper even in considerable amounts has no effect other than producing results similar to an overdose of table salt. Bernatzik determined that after entering the stomach only small quantities of copper are absorbed by the blood and a toxic action is only possible when a considerable amount accumulates in the circulation. Silver, copper and zinc have almost the same medicinal properties, the difference being that of degree rather than kind. These metals differ markedly from the other heavy metals, having no harmful effect upon the tissues, and producing no fatal functional injury, hence they are not poisonous in the same sense as are lead, mercury, arsenic, antimony and phosphorus.

Dr. Paull, editor of the *Pharmaceutical Journal* of England, was able to trace 99 per cent. of the copper as passing away from the body and many other investigators have established the fact that there is no cumulative action with this metal.

Strange as it may seem, there does not exist an authentic case of copper poisoning either in this country or abroad. At the congress at Brussels, where this subject was discussed for more than six months and which was attended by the strongest opponents of copper there was not a single instance of copper poisoning which could be brought forward that would stand the scrutiny of the congress.

In our own country, those toxicologists and physiologists who have given the subject sufficient attention to be competent to pass judgment are, without exception, agreed that copper in the amount used for the purification of water is without harm. I can not quote these here, but both in private letters and in published statements their verdict is in favor of the harmlessness of copper. I wish there were opportunity to quote at length from these men, but it is impossible at this time. It is, perhaps, sufficient to state that one of the best known of these authorities refers to the very point that was brought out to-night by one of the speakers. That is, that the finding of copper in the human body is one argument which may be used in demonstrating its universal distribution as well as its innocuousness to man. It is a well-known fact, of course, that a great many analyses have shown copper present in the body as high as forty to fifty parts per million. In the flesh of other animals, in milk and eggs, copper has been detected in varying quantities a number of times.

Finally, the reversal of the opinion of those who have such matters in charge in other countries is worthy of notice. The Italian government now allows 100 mg. per kilo in preserved vegetables and the following letter from the Prefecture of Police shows the change in position of the French Government:

Up to the year 1899 the subject of the possible bad effects on the health of the people by the introduction of sulphate of copper in the preparation of preserved vegetables had not been so much studied as it has of late, the scientific opinion being divided. But since that time the consulting committee has been renewed, and has again taken up the question and passed on the experiments made by private parties both as to the quantity of copper that the human body can consume without danger to health, and the proportion that the various preserved foods that are colored green may contain. From these experiments they came to the conclusion that there was no longer any reason to oppose the system of greening preserved vegetables by means of the salts of copper.

Consequently it is now allowable in France to use salts of copper for preserving the green color in food products in any amount, although until the harmlessness of this metal became known it was forbidden to even use a copper vessel for preserving purposes.

After all, the question is not a new one in this country, the introduction of Bordeaux mixture as a fungicide some years ago necessitating the fighting over of the whole subject of the effect of copper upon man. At that time one board of health ordered tons of grapes that had been treated with Bordeaux mixture to be dumped into the water, and it was not until Dr. Galloway and others connected with the Department of Agriculture at that time, showed how impossible it was to do any injury with this solution that the popular prejudice began to die out. Nowadays no one thinks anything about whether the fruit he is eating has been treated with copper or not.

The objections to the use of copper sulphate, because careless or ignorant people in charge of water supplies might add too much, hardly seems to require an answer. Since there would be no difficulty in tasting the copper long before an amount sufficient to cause inconvenience could be consumed, and since by the addition of lime we can almost immediately eliminate any excess of copper, it would seem that we had as many safeguards for this method as for any which could ever be introduced. Certainly, the danger of mismanagement and fatal error is nothing like so great as for sand filtration. It might be a good plan to encourage any method that would emphasize in any way the importance of putting the public water supplies of this country into the most competent hands possible. That the public is unable to detect failures in filtration plants until the death rate begins to rise, might be urged against this system of water purification. Certainly it is time we realized that filtration is one of the most delicate operations in sanitary science and that neglect or ignorance is constantly causing a reduction in the efficiency of this method. The man who makes public the cases of adding unfiltered to filtered water, the running of filters at too high a rate, the leaks in basins, conduits, etc., and the many other defects which are constantly occurring with this method may appear to be an enemy of sand filtration. In reality he would probably do more to compel authorities to raise this method to the efficient place it ought to have, but does not occupy at the present time, and would be of more real service to his country than many of us are able to realize.

Any one who has read the published accounts of the copper sulphate method as devised by the Department of Agriculture can not but admit that a most conservative stand has been taken regarding it. Over and over again is the statement made that it was not designed or intended to replace efficient methods now in use. The only claim made for it by its originators has been that it in one case furnishes a remedy for a condition previously considered hopeless, and in the other case as an emergency method, owing to the failure of means already in use, it offers the best way of quickly, thoroughly and cheaply sterilizing a large body of water that has yet been devised.

Copper sulphate is a remedy designed to correct a specific difficulty of great importance from the standpoint of comfort and public health. Each water supply requires a specific prescription and, if properly treated, I believe the evidence brought out here to-night guarantees a cure.

Contributions to the discussion were also made by Dr. G. Lloyd Magruder, Dr. Geo. M. Kober, Dr. Wm. C. Woodward, health officer, and Hon. H. B. C. Macfarland, president, Board of Commissioners, District of Columbia.

SCIENTIFIC BOOKS.

REPORTS OF THE BELGIAN ANTARCTIC EXPEDITION.

Résultats du Voyage du S. Y. Belgica en 1877–8–9, *sous le commandement de A. de Gerlache de Gomery.* Rapports Scientifiques, publiés aux frais du Gouvernment Belge, sous la direction de la Commission de la Belgica. Anvers, J. E. Buschmann, 1904. 4to, illustrated.

Additional volumes of the reports of the *Belgica* expedition have reached us as follows: *Hydroiden* von Professor Dr. Cl. Hartlaub (September 15, 1904, pp. 1–19, pl. I.–IV.); *Nemertinen* von Dr. Otto Burger (August 30, 1904, 12 pp., pl. I.–II.); *Poissons* par Louis Dollo (October 15, 1904, 240 pp., pl. I.–XI.); and *Observations Météorologiques horaires* par Henryk Arctowski (August 20, 1904, 201 pp., pl. I.–XXIII.).

The journal of the *Belgica* wintering among the Polar floes has furnished the first meteorological record taken during an entire year which has been obtained from the Antarctic. It is true that observations, taken at an isolated spot in a vast area of which the conditions are unknown, have only a relative importance, which however will grow with the increase in reports from other stations. But, as the pioneer in a virgin field, the observations possess intense interest to the meteorologist.

The volume contains preliminary chapters on the outfit, the special difficulties encountered, the general results, the complete record of observations and plates showing graphically the automatic records and the results displayed as wind-roses, etc.

Space fails for a complete analysis of the conditions encountered, but a few notes may be given. The mean annual pressure of the atmosphere was 744.4 mm., with a June maximum observation of 772.1 and a March minimum of 711.7. The minimum monthly mean occurred in February (735.68) and the maximum in June (750.55). The extreme maximum diurnal variation was 21.4 mm. in September, the minimum in the summer months, 8.6 mm. in December. In examining the profile for the year two maxima (June and December) and two minima are distinctly indicated, corresponding to the solstices and equinoxes.

The mean temperature for the year was minus 9°.64 C. with a maximum of plus 2°.5 and a minimum of minus 43°.1. The mean diurnal variation was 7°.57 and the maximum for a single day 27°.4.

The winds from the west and east predominate markedly over those from the north and south. It is noticeable that the northeast and and southeast winds were much more common than those from the northwest and southwest, though the west winds were slightly in excess of those from the east. It is probable that further observations are needed to enable any sound generalizations to be made.

The prevalence of clouds was almost constant, during the period of observation there were 5,473 hours of total cloudiness against only 901 hours of clear sky. During 82 days the sky was totally obscured, while during the whole period there were only two days wholly clear. It was raining or snowing 23 per cent. of the time and foggy 19 per cent. For the whole year there were 260 snowy days, but only 20 on which rain fell.

The report on the fishes, after some historical notes, discusses them under two heads—Antarctic, from within the Antarctic circle, and Subantarctic, chiefly from the Magellanic region. All the Antarctic fishes collected by the *Belgica* expedition are species or types which elsewhere belong in water abyssal or of greater depth than one hundred fathoms. No pelagic or littoral species were taken, and only on one or two occasions were specimens which might have proved to be surface species observed. Attempts at fishing with hook and line in moderate depths were unsuccessful, the stomachs of seals never and of birds only once contained débris of fish. The author notes that the expedition on the *Southern Cross* which followed the *Belgica* in 1898–1900, was the first to bring back littoral fishes, as well as pelagic forms, the former represented by species of *Scopelus* and *Pleuragramma,* the latter, *P. antarticum* Boulenger, being the most southern fish known up to the present time. The expedition on the *Erebus* and *Terror,* under Ross, was the first to discover and describe a true Antarctic fish, but it is to be anticipated that the recent expeditions will add largely to the present list.

The fishes taken by the *Belgica* belong to three families, Nototheniidæ, Macruridæ and Raiidæ, all new, and comprise five species of as many genera, represented by specimens and egg cases. The latter are supposed to represent a new species, of which the fish itself *Raia arctowskii* Dollo, was not obtained. The naturalist of the *Belgica* also collected seven Subantarctic fishes, all known forms. The author has made of his report a general summary of the ichthyology of the Antarctic regions, with a great wealth of detail and discussion of derivation, evolution and distribution, as well as of the relations of the fauna to hypotheses of a former Antarctic continent, in which he concludes that all the known facts lend themselves to explanation by Osborn's hypothesis.*

Bürger finds the collection of nemerteans to contain four species of Antarctic origin, two *Amphiporus,* a *Carinina* and a *Tetrastemma,* all new. These are the first of the group to be obtained from the region. *Cerebratulus magelhaensis* Bürger and a new *Amphiporus* were also obtained in the Magellanic region, and are fully described and illustrated.

Fourteen Antarctic hydroids were collected, of which four are also known from the arctic regions. One species each belonged to the Haleciidæ, Campanulinidæ and Plumulariidæ, three to the Lafoëidæ, and three to the Sertulariidæ. There were no new genera, but of the species nine appeared to be new. Most of the specimens were obtained by the use of tangles from relatively deep water, and the material was sparse and fragmentary.

Wm. H. Dall.

Introduction to Pharmacognosy. By Smith Ely Jelliffe, Professor of Pharmacognosy in Columbia University. Philadelphia, W. D. Saunders. 1904. 8vo. Pp. 275; 74 figs.

Pharmacognosy, dealing mainly with the same material and using the same methods as does plant histology, has long been in need of treatment at the hands of one familiar both with the pure science and with the needs of the modern special student. Admirable works on the subject have appeared in other languages, but a great lack has existed in English. The present volume is one for which English-speaking students should be thankful.

The work falls into three divisions, animal drugs, vegetable drugs without organic structure, and vegetable drugs with organic structure. The first division is appropriately small, and the last constitutes the major portion of

* Science, XI., p. 566, 1900.

the work. A goodly treatise on each drug is found, embracing references to its origin; discussions of its gross structure, microscopic structure and features recognizable in its powder; and mention of constituent substances present.

Although no attempt is made to include all the drugs, yet few important ones will be missed by the student looking for information.

Excellent original illustrations accompany a large number of the descriptions. It is to be regretted that these are in some cases replaced by inferior mechanical reproductions of plates in larger works.

The discussions are in the main botanically correct and the style is fairly clear. The treatment of *Polygala senega* leaves something to be desired from the standpoint of anatomical accuracy. One wonders a little, too, at such expressions as 'Therefore the cork cambium of the wood bark produces an apparently abundant periderm,' and 'the nucleus of the young plant,' in speaking of the structure of seeds.

Imperfections aside, however, it is well within the truth to say that this volume is the nearest approach which has yet appeared towards filling the need of the day in this country.

Charles H. Shaw.
Medico-Chirurgical College
of Philadelphia.

SCIENTIFIC JOURNALS AND ARTICLES.

The January–February number of *The Journal of Geology,* which is the first one of Vol. XIII., contains a paper by Professor Albrecht Penck, of the University of Vienna, on 'Glacial Features in the Surface of the Alps.' He concludes that "The actual surface features of the Alps do not at all correspond to those of a water-worn mountain range. Their conformation is mostly due to ice-action." Mr. E. B. Branson contributes a systematic paper on fish teeth, entitled 'Notes on Some Carboniferous Cochliodonts, with Descriptions of Seven New Species,' which is illustrated by two plates. Dr. Charles P. Berkey describes the 'Laminated Clays of Grantsburg, Wis. (with Chronological Deductions),' which is illustrated by a map showing the glacial deposits of that region. Mr. Edward M. Shepard gives an interesting account of 'The New Madrid Earthquake,' accompanied by five figures, and states that 'the elevation and depression of the land in the New Madrid region * * * were due to the great artesian pressure from below.' Dr. Charles R. Keyes contributes a paper, with five figures, on the 'Structure of Basin Ranges' as found in New Mexico. Professor Stuart Weller contributes a valuable article on 'The Classification of the Upper Cretaceous Formations and Faunas of New Jersey.' It contains a valuable chart showing the equivalence of the classifications of Cook, 1868; Clark, 1892–1904; Knapp-Kümmel, 1898–1904; and Weller, 1905.

The American Geologist for February contains, as the leading article, a paper by Dr. Alfred C. Lane on 'The Coarseness of Igneous Rocks and its Meaning,' illustrated by a plate showing the 'Luster-mottling in Drill-cores of Ophites.' Professor L. C. Glenn contributes a biographical sketch, with portrait, of 'Gerard Troost,' the first state geologist of Tennessee. 'Notes on Some Rocks and Minerals from North Greenland and Frobisher Bay,' illustrated by a plate showing the banded limestone of Frobisher Bay, is published by Professor B. K. Emerson. The 'Montana Gypsum Deposits' are described by Professor Jesse P. Rowe. The deposits are divided into the North Field, concerning which little is known; the Middle Field, given as of Carboniferous age; and the South Field, which is regarded as in the same formation as the gypsum beds of Wyoming and as of Permian or Triassic age. The paper is illustrated by three plates giving six views of the gypsum deposits and a map showing their distribution.

The Museum News for April, published in the interest of the museums of the Brooklyn Institute is issued in place of the *Children's Museum News* and will deal with matters relating to both the Central and Childrens' Museums. Its object will be to keep the public advised of changes in and additions to the collections, and to note the general work of the museums and advantages offered in the way of lectures and material. Among other things it notes the formal turning over of the Central Section of the Museum Building on Eastern Parkway to the Institute, and the opening of the Ethnological Hall.

Bird Lore for March–April contains articles on 'The Cormorants of Great Lake,' by T. Gilbert Pearson; 'Mark Catesby,' by Witmer Stone; 'The Chimney Swift,' by Guy A. Bailey. There is a list of 'Bird Lore's Advisory Councilors' and the ninth paper on the 'Migration of Warblers,' by W. W. Cooke, a note on 'The Warbler Book' and a sketch of 'The Worm-eating Warbler,' by Frank L. Burns. There are important book reviews and important matter in the section devoted to 'Audubon Societies.' In connection with the 'Educational Leaflet' devoted to the ostrich it would be interesting to know if any of the North African *Struthio camelus* are to be found in captivity. All the eggs for sale are those of the South African species *S. australis*.

The Museums Journal of Great Britain for March is a specially interesting number and opens with an article by John MacLauchlan on 'Government Aid to Country Museums,' which shows what has been done in Great Britain. It is interesting to note in connection with the proposed establishment of a 'Welsh National Library and Museum' that various cities have offered very substantial inducements in order to have the institution located in that particular place. There is a notice of David Murray's three volume work, entitled 'Museums, their History and their Use,' and the balance of the number is given over to notes of many museums, including a notice of the recent appointment of Sir Purdon Clarke to the directorship of the Metropolitan Museum of Art. The very full directory of British museums has advanced as far as Portsmouth.

SOCIETIES AND ACADEMIES.

THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE seventh regular meeting of the San Francisco Section of the American Mathematical Society was held at Stanford University on February 25, 1905. Fourteen members of the society were present. A number of other teachers of mathematics living in or near San Francisco attended both of the sessions. The following papers were read:

PROFESSOR H. F. BLICHFELDT: 'On a theorem due to C. Jordan.'

PROFESSOR H. F. BLICHFELDT: 'On the order of the collineation-groups in five variables.'

PROFESSOR A. W. WHITNEY: 'A theorem in the theory of probabilities, and its application to insurance.'

PROFESSOR R. E. MORITZ: 'A general theorem on local probability.'

PROFESSOR E. J. WILCZYNSKI: 'Projective differential geometry of plane curves.'

DR. W. A. MANNING: 'On the primitive groups of class ten.'

PROFESSOR G. A. MILLER: 'Invariant sub-groups of prime index.'

PROFESSOR IRVING STRINGHAM: 'A geometrical construction for quaternion products.'

PROFESSOR A. O. LEUSCHNER: 'On the general applicability of the short method of determining orbits from three observations.'

PROFESSOR T. J. J. SEE: 'On the physical state of the matter of the earth's interior, with considerations on terrestrial geology, and on the comparative geology of the other planets.'

In the absence of their authors the papers by Professors Moritz and Wilczynski were read by Professors Leuschner and Haskell, respectively. The paper by Dr. Manning was presented by Professor H. C. Moreno. The next meeting of the section will be held at the University of California on September 30, 1905.

G. A. MILLER,
Secretary of the Section.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 598th meeting was held March 18, 1905.

Mr. F. B. Littell, of the Naval Observatory, read a paper on the 'Progress of the Eros Solar Parallax Campaign.' He told in detail of the elaborate plans of work, of the numerous astronomers cooperating in it and of the results thus far obtained. Twenty-eight observatories furnished 6,600 visual observations and thirteen furnished photographic plates; of these, 835 have been measured, reduced and published, those from Paris being the best; 2,100 plates are still unpublished. Each observatory publishes its own work and the combination of the results has been left so far to voluntary workers. One computer deduces from about 300 plates, taken at nine places, a parallax of $8.''7996 \pm .0021$.

Mr. J. E. Burbank then spoke on the 'Records of Earthquake Disturbances on Magnetographs of the Coast and Geodetic Survey.' Such records occasionally show disturbances markedly different from any usual magnetic disturbance; thus in the last few years some forty of them have been noted at Baldwin, Kansas. The speaker had attempted to compare all such disturbances found on records from half a dozen observatories with one another and with simultaneous records of seismographs. In spite of marked differences in time and duration there is so large a number of coincidences in time as to justify the belief that they have a common cause in an earthquake wave, although the speaker is not prepared to present any theory of the phenomena.

CHARLES K. WEAD,
Secretary.

THE TORREY BOTANICAL CLUB.

MINUTES of a meeting held March 14, 1905, at the American Museum of Natural History.

The first paper on the scientific program was by Dr. N. L. Britton, and was entitled 'A Botanical Cruise in the Bahamas.'

The speaker had just returned from several weeks' exploration in the Bahamas and gave a general account of the trip. The numerous islands—there are over 2,700 islands, keys and projecting rocks—are all of the same general type in that they consist of coral limestone. The group is so scattered that there is considerable variation in temperature and rainfall.

A remarkable feature of the islands is the abundant and almost impenetrable thickets growing directly out of the rock; in fact there is very little soil except that known as 'red land,' which occurs in the bottom of sink-holes and locally in swales, and the 'white land' formed from the crumbled rock either disintegrated in place or accumulated as sand dunes. These two formations represent practically all the tillable land of the islands.

Owing to the porous nature of the material there are no known permanent fresh-water streams, although there are a number of salt-water creeks of considerable size. Occasionally there are fresh-water ponds and marshes, mostly of small size. These very local ponds and marshes furnish many of the botanical novelties. Salt-water ponds which rise and fall with the tide are abundant and sometimes of large size.

The Bahamas are very recent geologically, the Bahaman uplift being placed not earlier than the late Tertiary, so that they offer excellent opportunities for the study of plant migration and evolution.

The flora is of southern derivation, a large number of the known indigenous species being common to the near-by and older islands of Cuba and Hayti, while many other species are closely related to plants from these islands. The chief agents in the introduction and distribution of the plant population are migratory birds, supplemented by winds and ocean currents. Notwithstanding the geologically short period that the Bahamas have been above the sea, they have witnessed the evolution of numerous species, there being many endemic species known and many more which will be made known as the result of the recent explorations. Many of these, it is believed, will prove to be examples of rapid evolution (mutation).

Dr. Britton's observations were followed by remarks on 'Collecting Algæ in the Bahamas' by Dr. Marshall A. Howe. The shores of the islands were said to offer a considerable variety of physical conditions and to have a marine flora which is on the whole varied and rich, though apparently less so than that of the Florida Keys. The shore lines are usually rocky, but there are often stretches of white sand which are nearly destitute of algæ. The tide rises and falls ordinarily from one to four feet, but the withering effect of the sunshine is such that few species are found in the strictly littoral zone except under shelving rocks or where the shore is subject to an almost continuous spraying from the waves. A deeply shaded shelf under a remarkable rock overhang on the Cave Cays of the Exuma Chain furnished some of the most interesting algæ obtained on the recent expedition. The so-called creeks constitute good collecting grounds, especially if well exposed to tidal currents, and the roots of the red mangrove, which commonly borders such, always harbor algæ of interest, particularly when standing in water that is three feet or more deep at low tide. Nearly all the larger islands have brackish ponds which have a peculiar flora varying in character with the salinity of the water. Hundreds of square miles in the Bahaman region are occupied by the 'banks,' on which the water is very shallow, mostly from five to twenty feet deep; these banks often consist of clean white sand with little visible organic life, yet in many places are found, more or less abundantly, representatives of such genera as *Penicillus, Rhipocephalus* and *Udotea,* growing directly out of the sand, and *Microdictyon, Gymnosorus, Wurdemannia, Laurencia, Chondria, Herposiphonia* and others, attached to sponges, corals, sea-fans, etc. In the winter and spring months, at least, very little is found washed ashore except species of *Sargassum* and their epiphytes.

The speaker remarked upon the desirability of extensive dredging operations in order to complete our knowledge of the marine flora of the Bahaman archipelago. A few characteristic specimens of Bahaman marine algæ were exhibited. Special attention was directed to four species of *Penicillus,* viz., *P. capitatus, dumetosus, Lamourouxii* and the recently described *Penicillus pyriformis.*

Rhipocephalus Phœnix and *oblongus* and various species of *Udotea, Avrainvillea* and *Halimeda* were also discussed.

Mrs. Britton, who accompanied the expedition, spoke more particularly of the flora of the island of New Providence, where she spent the time collecting while the other members of the party were cruising. Several exceedingly fine photographs of the local scenery were exhibited.

EDWARD W. BERRY,
Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE 156th regular meeting was held February 9, 1905, in the chemical lecture hall of the George Washington University. Professor W. R. Whitney, of the research laboratory of the General Electric Company, delivered an experimental lecture upon the subject, 'Colloids.'

THE 157th regular meeting was held March 9, 1905, in the assembly hall of the Cosmos Club.

The first paper on the program was delivered by Mr. W. L. Dubois, and entitled 'Notes on Sulphur Determination.'

For the determination of sulphur in foods and feces a modification of Newmann's method, consisting of burning the sample with sodium peroxid and sodium carbonate, has been substituted for Osborne's method in the Bureau of Chemistry. The new method possesses these advantages: (1) combustion is more satisfactory, cases of incomplete burning being rare; (2) many more samples can be handled, owing to greater ease of manipulation; (3) economy of sodium peroxid.

The most satisfactory lamp tried at the Bureau of Chemistry is Barthel's alcohol burner, which may be adjusted from a very low flame to a powerful blast.

The second paper was entitled 'The Grignard Reaction,' and was presented by Dr. C. E. Waters.

This is one of the most valuable methods of organic synthesis that has been devised recently. An organic halide, RX, dissolved in ether, is allowed to act upon magnesium turnings, which dissolve, forming a clear solution of RMgX. This solution gives addition-products with aldehydes, ketones, esters, ketone- and hydroxy-acids, with sulphur, selenium, oxygen, carbon dioxide and oxychloride, cyanogen, oxides of nitrogen, and other classes of compounds. When these addition-products are treated with water or dilute acids a number of different classes of products are obtained. By this method we can get primary, secondary and tertiary alcohols, ketones, hydroxy-acids, thio- and seleno-compounds, hydroxylamine derivatives, etc. With metallic halides there are formed organometallic compounds.

A special meeting of the Chemical Society of Washington was held Wednesday, March 29, 1905, in the chemical lecture hall of the George Washington University. At this meeting an illustrated lecture upon 'The Chemistry of Electrochemistry' was delivered by Professor W. D. Bancroft, of Cornell University.

A. Seidell,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.
CORNELL SECTION.

At the November meeting of the Cornell Section of the American Chemical Society, Mr. E. S. Shepherd spoke on 'The Importance of Physical Chemistry in the Study of the Strength of Metals.' After a brief introduction, the speaker traced the development of the pyrometric study of alloys and pointed out how inexplicable were the results obtained. The subject of metallography was discussed and it was shown how neither metallography nor pyrometry could, unaided, solve the problem of the constitution of alloys. It was then shown that physical chemistry furnished a simple explanation of all the facts observed. The equilibrium diagrams for iron-carbon, copper-tin and copper-zinc were discussed. The theory of hardening steel and tempering was briefly explained. By means of the tensile strength curves the speaker showed what a great change in the physical properties of the bronzes can be induced by suitable heat treatment. Quoting results obtained by Shepherd and Upton working on a grant to W. D. Bancroft from the Carnegie Institution, it was shown that certain bronzes could have their tensile strength doubled by heat treatment. Thus a bronze containing 81 per cent. of copper would show a strength of 73,000 pounds per square inch if quenched from above 500° C. and only about 30,000 pounds per square inch when annealed. It was shown how the elongation of the 97 per cent. copper bronze was 30 per cent. for a quenched bronze and only 3 per cent. for the annealed. From these and the similar changes in iron and steel the speaker pointed out the very great need for equilibrium diagrams as a basis for further investigations of the mechanical properties of metals. The speaker mentioned the great value of metallography, pointed out its limitations and was of the opinion that it was only one of the several essential methods of investigation.

In closing, the speaker discussed the work of Beiltry on the surface flow, and hard and soft states of metals. The lecture was illustrated by a large number of lantern slides.

W. S. Lenk,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

At its regular meeting, February 17, the academy elected the following officers:

President—Professor T. C. Hopkins.
Vice-President—J. D. Wilson.
Recording Secretary—Philip F. Schneider.
Corresponding Secretary—J. E. Kirkwood.
Treasurer—Mrs. L. W. Roberts.
Councilors—A. M. Reese and E. N. Pattee.

Professor W. M. Smallwood presented the following facts concerning a tumor in the kidney of a frog:

During the past semester in one of the elementary courses in the university while dissecting the frog it was noticed that the kidneys of one were abnormally large and irregular in shape. They were at once fixed in Carnoy's fluid and subsequently studied with some care. The kidneys were about four times as large as the normal kidneys and showed no evidence of the presence of the adrenal in its normal position. A study of the cytology revealed the presence of a tumor resulting from the abnormal growth of the adrenal tissue. A comparison of these conditions with available human adrenal tumors showed a very striking agreement not only in the general arrangement of tumor tissue to the kidney tissue, but also in the finer details of structure. This agreement is so striking as to leave no doubt but that the pathological conditions in the frog are to be characterized as an adrenal tumor. It is interesting to note that similar results obtain in such widely different animals as the frog and man. A full report will appear soon in one of the current journals.

AT the meeting on the evening of the seventeenth of March Mr. E. D. Congdon addressed the meeting on 'Some Zoological Impressions of the Bermudas.' Mr. Congdon's abstract of his report follows:

In company with some thirty other students of biology, I had the pleasure of spending part of the summer of 1903 at the Bermuda Biological Station. We were under the supervision of Dr. E. L. Mark, of the Harvard department of zoology, and Dr. Bristol, of New York University. We were comfortably lodged at Hotel Frascati on the outlet of Harrington Sound, midway in the southern shore of the island. No spot could have been found more accessible to the good collecting grounds of the beach, the reefs and the sound. The steam launch and the carryalls supplied transportation to the places chosen for each day's exploration. The trips were so planned as to include all of the diverse collecting grounds of the islands. Those who were investigating particular subjects were aided in every way to find the material they required.

Time was about equally divided between the reefs and the beach. The whiteness of the coral sand and the clearness and warmth of the water made the search easy and altogether agreeable. Among other interesting forms, *Balanoglossus* occurs in restricted localities along the beach. The dredge brought up from the bottom of Harrington inlet a goodly amount of *Amphioxus*. Mollusca are well represented in species and individuals and include four classes. An *Aplysius*, a tectibranch devoid of shell, could be found by scores in sheltered coves. Sometimes when disturbed they emit a violet fluid which may well serve as a protection, as it diffuses through the water. An exciting encounter with an *Octopus vulgaris* occurs to mind. It resented the advances of a too inquisitive biologist by jerking an oar from his hand. It finally escaped by its power to imitate the exact shade of any brown or gray rock upon which it comes to rest. The grouper, a common Bermuda fish, shows a similar ability to adapt its color to that of its surroundings through a considerable range of colors.

The Cœlenterata are the most characteristic group of animals along shore. The Bermuda anemone, *Actinia mesembryanthemum*, attracts collectors by its large size and the beauty of its variable coloring. In restricted localities where there is considerable tidal current the hydroids *Eudendrium ramosum* and *Pennaria tiarella* are abundant. A small and beautiful *Eudendrium* previously unrecorded was found in a single cove on the south shore. Including the forms which come in on the drifting *Sargassum*, at least eighteen species occur. The beaches of coral sand are dotted with corals of the genera *Isophyllia*, *Mœandra* and others.

The life of the coral reefs is abundant and beautiful. One would not suspect that Bermuda is the northernmost of coral islands. The Gorgonia, Porites, Millepora, Oculina, together with ascidia, sponges and algæ furnish bright and contrasted colors. Movement is given to the coral gardens by the reef fishes with their predominantly blue, black and yellow coloring.

A series of small round half submerged islands occurring along the south shore are of organic origin. Their substructure is of coral sandstone and is honeycombed by the waves. Their surfaces have been encrusted by the tubes of Serpulæ, which in the course of growth have given the islands their characteristically round form. The waves of the open Atlantic pouring into their cavities render fitting their local name, 'the boilers.' Though difficult of access in the quietest sea, they well repay the attention of the collector.

Thirty miles south of Bermuda lie banks described but not explored by the *Challenger* expedition. Two days of intense interest were spent fishing and dredging over this virgin territory. Fish were so abundant as to rob their capture of half its zest. The typical blue coloring of the surface fish fauna was noticeable. The red snapper and a few other fishes suggested the coloring of the zone of rose red algæ.

The dredge brought up among algæ, echinoderms and hydroids two specimens of the spotted moray. Perhaps the most interesting things which came from the surface of the banks were a number of calcareous spheres three or four inches in diameter. They were composed of thin concentric layers and were apparently of organic origin. Further than this no explanation of their origin was forthcoming.

Alfred Russel Wallace has pointed out how typical the Bermudan terrestrial fauna is of an oceanic island. Only three indigenous vertebrates are present otherwise than birds. It is significant that the only mammal is winged, a bat. He expresses surprise at the small number of insects described. Since the publication of his book the list has been swelled to over three hundred. That a considerable proportion are not indigenous is evident from the fact that twenty species were found en route for Bermuda on one ship sailing from New York. The gulf stream flowing within one hundred miles to the west of Bermuda, the drift of the surface water from the south and west, and the West India hurricanes were no doubt the important agents in bringing animal life from the North American continent.

J. E. Kirkwood,
Corresponding Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA.

The 159th meeting of the society was held in the chemical lecture room, Tuesday, 7:30 p.m., March 14, 1905. The following papers were presented:

Professor A. S. Wheeler: 'Normal Paper.'

Professor W. C. Coker: 'The Mutation Theory.'

Professor J. E. Mills: 'Chemical Affinity: A Method for Distinguishing Chemical Energy from Simultaneous Physical Energy Changes.'

Alvin S. Wheeler,

DISCUSSION AND CORRESPONDENCE.

NATURAL MOUNDS.

In Dr. Brauner's interesting article on 'Natural Mounds' in Science for March 31, he mentions the fact, in connection with the distribution of these mounds in the Mississippi Valley, that they follow up the valley of the Arkansas and of the Neosho rivers across Indian Territory into southeastern Kansas. These mounds are exceedingly abundant in southwest Missouri also. They are a characteristic feature of the landscape in Lawrence County, Mo. (second tier of counties from Kansas and from Arkansas), where the writer lived for many years. They are abundant both in the timber and on the prairies, but are more noticeable on the prairies because of the fact that on them the prairie grasses give place to taller forms of vegetation. Before the lands were put in cultivation these mounds were from one to three feet high, and usually twenty to thirty feet in diameter. On newly reclaimed land crops grow much more luxuriantly on the mounds than elsewhere. Corn is usually the first crop planted on new lands in that section, and it is usual for corn on mounds to grow nearly twice as tall as on surrounding areas the first year. This difference in growth gradually disappears as cultivation continues.

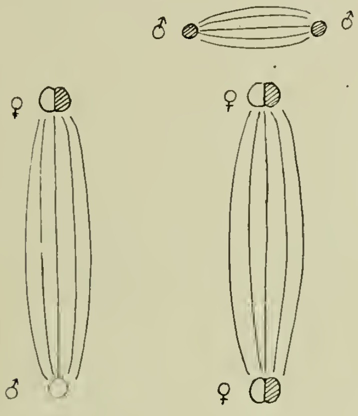
These mounds have probably originated from different causes in different regions. In southwest Missouri their origin is probably due to the following cause: The soil of the region has been formed from the decay of the great sub-carboniferous limestones. Where these strata are exposed in cliffs there may occasionally be found concretions of flint several feet in diameter. The flint is broken into rather small fragments, which fall apart more or less when the surrounding limestone disintegrates into soil. The flint resists disintegration far greater than the limestone. These masses of flint fragments later become prominent as mounds by the more rapid denudation of the surrounding soil containing comparatively little flint. This theory is strengthened by the fact that the material forming the mounds to a depth of several feet consists very largely of small flint stones.

W. J. Spillman.
U. S. Department of Agriculture.

SPECIAL ARTICLES.

AN ALTERNATIVE INTERPRETATION OF THE ORIGIN OF GYNANDROMORPHOUS INSECTS.

The occasional occurrence in the groups of ants, bees, wasps and butterflies of individuals that show male characters in certain parts of the body and female characters in other parts —the so-called gynandromorph condition— has long been known, and several suggestions have been made to account for the result. The view recently proposed by Boveri has met



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with the most favor. Before stating this view it may be well to recall that in bees it is generally admitted that unfertilized eggs give rise to male individuals (drones) *as a rule,* while fertilized eggs give rise to females (queens or workers). Boveri has suggested that the gynandrous condition may be due to the spermatozoon failing to unite with the egg nucleus, but subsequently pairing with one of the products of its first division, as shown in diagram A. If a union of this sort should occur, all of the cells that are derived from the paired nucleus might be expected to give rise to female characters (as in the case of the *fertilized egg*); while all the cells that come from the unpaired half of the nucleus might be expected to produce male parts. Hence the individual that develops from such an egg might be expected to show the characters of the two sexes combined in different ways according to the positions of the descendents of the two kinds of cells. On purely theoretical grounds I offer an alternate hypothesis which will explain the facts equally well. Moreover, if this view, rather than Boveri's, should prove to be the correct one it will furnish important data in regard to the value of the spermatozoon in determining the sex of the bee. I venture to suggest this alternation, especially, as the two views can be put to the test of actual observation by any one in position to obtain the necessary material; and also because the possibility of this interpretation appears to have been entirely overlooked as an explanation of gynandromorphism. I suggest in brief that the results may be due to two (or more) spermatozoa entering the same egg, one only fusing with the egg nucleus, and the other not uniting, but developing without combining with any parts of the egg nucleus, as shown in diagram B. The products of division of the paired nucleus will account for the female parts of the embryo, while the products of the division of the single sperm nucleus will account for the male characters of the other parts. The assumption of polyspermy on my view is not arbitrary, for it has been often described for the bee and other insects, and seems to be of frequent occurrence. As a rule it appears that the spermatozoa that do not unite with the egg nucleus fail to develop, but under exceptional cases they may do so. In fact, several cases of 'male parthenogenesis' in other forms have been described in recent years.

It will be observed that on Boveri's hypothesis the male characters will be derived from the egg nucleus, while on my view they will come from the unpaired sperm nucleus. If, therefore, a queen of one race and a drone of another should produce one of these gynandromorphs we ought to be able to decide which of these views is correct; for, on Boveri's hypothesis, the male characters of the gynandromorph would be those of the race to which the mother belongs, while on my view they would be those characteristic of the race of the father. Thus if an Italian queen-bee were to be fertilized by a German drone and a gynandromorph produced, the male parts should be Italian on Boveri's view, and German on mine.*

* I am aware, of course, of the prolonged discussion that has taken place in regard to the character of hybrid bees, but despite these difficulties the test might still be made, especially as the drones are generally described as purely paternal.

Von Siebold had in fact a case of this sort in the famous Eugster hive from which he obtained his material. Unfortunately his statement in regard to the racial characters of the gynandromorphs is obscure. The following quotation is the only reference that he has made to the racial characters of these bees.

Die fünf Jahre Königen dieses Stockes war eine reine Italienerin und hatte nichts Auffallendes an sich. Sie musste sich mit einer deutschen Drone begattet haben, da sich ausser reinen italienischen Arbeitern auch noch viele Bastardarbeiter von verschiedener Abstufungen in demselben Stocke befanden, während die Drohnen dieses Stockes ihre reine italienischen Abkunft verriethen. Auch die Zwitterbienen [gynandromorphs] dieses Stockes besassen die Färbung der italienischen Race; doch war dieselbe unter dem Einflusse der deutschen Race hier und dort getrübt worden.

In addition to the interest of determining which of these alternative views is the true explanation, there is, as I have pointed out, an implication in my hypothesis of more general importance. On my view the sperm-nucleus alone produces male characters, just as the egg nucleus alone produces male characters. If established, therefore, my view would show that in the bee the male and the female nuclei are exactly equivalent as sex determinants. Alone, either produces male characters, united in the same nucleus, they give rise as a rule to female characters. The results appear, therefore, to be quantitative and not qualitative. From this point of view the male nucleus is not the bearer of the female sex-characters (although both sexual characters may be latent in each nucleus), but combined the two nuclei give the characters of the female.

It is far from my intention to set one of these hypotheses over against the other, and to attempt to weigh their relative merits on the grounds of probability. I have raised the question not to invite discussion, but to appeal to those who may have an opportunity to examine gynandromorphs from mixed hives. Neither do I wish to appear to be propounding a theory of sex-determination, that will apply to other cases in which other factors than fertilization appear to determine the sex of the individual.

In the group of Lepidoptera it may seem at first sight that neither Boveri's view nor my own can explain the occurrence of gynandromorphs, because it is not the rule here that unfertilized eggs produce males, although this sometimes occurs. The discrepancy is more apparent than real, for, even if female butterflies develop from parthenogenetic eggs, *as a rule,* the same explanation used for the bees can *mutatis mutandis* be applied. If, for example, the egg nucleus alone, or the sperm nucleus alone, produces female characters then on Boveri's view when the sperm nucleus unites with one of the products of the first division of the egg nucleus the resulting cells may also happen in some cases to produce male characters (just as some of the fertilized eggs become males). The other half of the first division produces a female, on the theory, and a gynandromorph results. Under such circumstances the female side of the individual would show the character of the race to which the mother belonged, if a hybrid gynandromorph should be produced. If on the above assumption the united male and half female nuclei should produce a female instead of a male then both sides would be female, and there would be nothing externally to indicate that such an individual was different from an ordinary female. On my view also a formal explanation can be offered for the lepidopterous gynandromorphs. If the united nuclei should happen to produce male, and the single sperm nucleus should give rise to female characters a gynandromorph would result. In a hybrid of this kind of individual the *female* characters would be paternal. If the united nuclei happen to produce a female (since fertilized eggs may produce either males or females), and the sperm nucleus also produces a female, then both sides will be superficially alike, and nothing would indicate that such a female individual had had an abnormal origin.*

T. H. Morgan.
Columbia University.

* If male-determining and female-determining spermatozoa exist the gynandromorphous condition in the bee might also be accounted for on the

*THE TOTAL SOLAR ECLIPSE OF AUGUST 29–30, 1905.**

The path of the shadow of the moon during the eclipse of August 29–30, 1905, is conveniently accessible at several points; that fact, together with the large duration for totality which for the maximum is 3 minutes 45 seconds, renders the observation of this eclipse desirable.

A brief sketch of the location of the path of the shadow will show the comparative accessibility of the different parts. In general the width of the shadow path is approximately 120 geographic miles.

The moon's shadow strikes the earth at sunrise in the province of Manitoba near the south end of Lake Winnipeg. The shadow sweeps eastwardly through the British possessions, passing over the southern part of James Bay and the peninsula of Labrador, and enters the Atlantic Ocean about 100 miles north of the eastern entrance of the Strait of Belleisle, which separates Labrador from the island of Newfoundland. After leaving the American coast no land is met by the shadow until it reaches the north coast of Spain, where the middle of the shadow crosses the coast line about 100 geographic miles west of the city of Santander and sweeps southeastwardly across the Spanish peninsula, leaving Madrid

ground that a male spermatozoon as well as a female spermatozoon has entered the egg, the latter alone fusing with the egg nucleus. It might appear that a count of the number of the chromosomes in the male and female parts of the body of the gynandromorph would give an answer to the problem; for, on Boveri's view, the female-half might be expected to contain twice as many chromosomes as the male-half of the body. On my view the same condition might be expected, but if Petrunkewitsch's observations are correct, there is a doubling of the chromosomes in the later stages of the drone egg, and possibly the same increase in the number of chromosomes might happen in the descendants of the single sperm nucleus or the half egg-nucleus. The conditions were too uncertain to make an appeal of this sort of any value at present, and the other test that I have suggested offers apparently a simpler and safer means of reaching a conclusion.

* Circular of the U. S. Naval Observatory, March 18, 1905.

about 40 miles and Valencia about 2 miles distant from the southern edge and outside of the shadow path. Some of the cities within the limits of the shadow path are Leon and Burgos, not far from the central line, Valladolid, near the southern edge, and Zaragoza, near the northern edge, while the old city of Sagunto lies about 20 miles within the southern edge. The numerous railroads passing into and through the shadow path afford a means of access to observing stations from ports on the Bay of Biscay or the Mediterranean Sea.

After leaving the Spanish coast the shadow sweeps over the Columbretes, a group of small islands, close to the central line and about 40 miles from the coast. The Columbrete Grande, the largest of these islands, is less than a half mile long and rises to an elevation of 262 feet above the sea. This island is crescent-shaped and affords an anchorage protected in every direction except the northeast.

About sixty miles farther southeast the shadow passes over two islands of the Balearic group—Ivica, just within the southern edge, and Majorca, within the northern edge—but the only satisfactory harbor is the port of Palma, on the southern shore of Majorca and about 40 miles north of the central line.

After crossing the Mediterranean Sea the shadow strikes the African coast about midway between the cities of Algiers and Tunis. A railway line not more than 60 miles from the coast, connecting the cities of Algiers and Tunis, has various branches, by means of which observing stations may be reached at any desired distance from the central line of the shadow path.

In the vicinity of the shadow path several ports are available for landing. The port of Bona is located about 230 geographic miles east of Algiers and about 120 miles west from Tunis. It is supplied with a fine artificial harbor of 195 acres with an inner basin of 25 acres. This port is now one of the best and safest on the Mediterranean coast. It is visited annually by about 3,000 vessels and enjoys telegraphic communication with Marseilles and regular steamship connections with France, Algiers and Tunis.

The port of Benzert, on some maps called Bizerta, is located about 50 miles northwest from Tunis. The harbor facilities of Benzert, which are naturally very good, have been of late years very much improved by the French government by dredging and by protective works in order to make it the location of an extensive naval station. As a harbor it is very commodious and accessible to large vessels. It is connected with the railway system and is the terminus of a submarine cable.

The port of Tunis is inferior in harbor facilities to either Benzert or Bona, and need not be considered as a landing-point.

From this region the shadow path proceeds southeastwardly across the desert into Egypt, where it crosses the river Nile in the neighborhood of Assonan. The total phase occurs here something more than one hour before sunset. The shadow leaves the earth in central Arabia.

Some of the points to which the attention of astronomers will be directed may be briefly stated as follows:

(*a*) *The Relative Position of the Sun and Moon at the Time of the Eclipse.*—The angular distances between the centers of the sun and moon may be derived from observations of the four contacts, by visual or by photographic methods. This necessitates an accurate determination of the latitude and longitude of each observing station, which necessarily consumes a large amount of time and labor, and demands the use of a special instrumental outfit.

Since the position of the moon is so well cared for by meridian observations, and since the additional data derived from contact observations is small in quantity and of a distinctly lower grade in quality, it follows that contact observations should be considered of secondary importance compared with the work in other lines.

(*b*) *The Search for Intra-mercurial Planets.*—Hitherto photographic searches for intra-mercurial planets have been made with incomplete apparatus or have been interfered with seriously by clouds.

In this eclipse it is highly important that a photographic search be prosecuted at two or three widely separated stations with very complete apparatus.

(*c*) *The Corona.*—The corona should be photographed with long focus lenses to obtain large scale pictures of the inner corona, and with short focus lenses for pictures of the corona as a whole embracing its ultimate extensions. It would be well to locate the parties at a number of widely separated stations, and Professor Campbell, director of the Lick Observatory, suggests the use of lenses of a standard aperture and focal length, say five inches aperture and forty feet focus, to furnish data for studying changes in the corona as the shadow sweeps over the earth.

The work on the corona should be considered of the highest importance.

(*d*) *Spectrum Work.*—All the facilities available to the astronomy of the present day for photographing the spectrum of the reversing layer, the chromosphere, the prominences and the corona, should be used to their utmost capacity in the coming eclipse. On account of lack of light the slit spectroscopes used will be confined to a few special problems, leaving the great bulk of the work to be executed by objective spectrographs, using either gratings or large prisms.

It is also suggested that a number of spectrographs be employed to determine the accurate wave-length of the principal coronal line.

The spectrum work should be considered of equal importance with that on the corona.

(*e*) *Photometry; Shadow Bands.*—Of secondary importance are photometric observations and observations of the character of the so-called shadow bands.

(*f*) *Polariscopic Work.*—Polariscopic and polarigraphic work should be well cared for with increased facilities for accurate work.

Polariscopic work should be considered of importance nearly equal to that on the corona and the spectrum.

(*g*) *Meteorology.*—The meteorological conditions existing at the several stations, especially during the progress of the eclipse, should be observed by means of the best self-recording instruments.

This should be considered the most important of the secondary work.

At the present time it is not possible to note many details in reference to the location of the various parties intending to observe this eclipse, but it is reasonably certain that the observers will be quite well distributed over the accessible portions of the path.

The Canadian government expects to locate a party on the coast of Labrador, about 100 miles north of the Strait of Belleisle.

The Indiana State University announces its intention to locate a party in Spain.

The German government has asked permission of Spain to land a party on the Columbretes islands.

One English party will probably locate near Palma on the island of Majorca, one of the Balearic group.

Other English parties will undoubtedly locate in Spain.

Professor Campbell has announced that, through the liberality of Mr. William H. Crocker, the Lick Observatory will send out three different parties for observing this eclipse, one of which will be located on the coast of Labrador, a second in Spain and a third in Egypt.

The director of the observatory of Pulkowa, Dr. Backlund, has indicated his intention to equip two observing parties.

Under an appropriation of $5,000 by Congress, the Naval Observatory will undertake the observation of this eclipse and will equip an expedition. The U. S. S. *Columbia* and the U. S. S. *Cæsar*, vessels detailed by the Navy Department, will carry to ports near the observing stations the expeditionary force, which will consist of the following: Rear-Admiral C. M. Chester, U. S. N., superintendent Naval Observatory, in charge of the expedition, with about seven members of the staff of the Naval Observatory. Mr. L. E. Jewell, of Johns Hopkins University; Dr. S. A. Mitchell, of Columbia University, and Dr. N. E. Gilbert, of Dartmouth College, have accepted invitations to participate in the work of observation. Professor F. H. Bigelow, of the U. S. Weather Bureau, will accompany the expedition and have charge of its meteorological work.

The equipment for three observing stations is being prepared, the more important elements of which are as follows:

1. A station near the central line, possibly on one of the islands of the Columbretes group off the east coast of Spain; a horizontal photographic telescope 5-inch aperture and 40-foot focus; a photographic telescope 8.5-inch aperture and 12-foot focus; a 6-inch Dallmeyer camera, 36-inch focus; a portable telescope for contact observations; several grating spectroscopes; spectral photometric apparatus; meteorological apparatus.

2. A station 10 to 15 miles within the edge of the shadow path, probably near Valencia; a horizontal photographic telescope 7.5-inch aperture and 65-foot focus; a prismatic spectrograph; a photographic telescope 9.6-inch aperture and 14-foot focus with color screen; a 6-inch Dallmeyer camera 40-inch focus; a portable telescope for observing contacts; a grating spectrograph; meteorological apparatus.

3. A station near the central line, probably near the line of the railroad from Tunis to Algiers in Africa; a horizontal photographic telescope 5-inch aperture and 40-foot focus; a photographic telescope 7-inch aperture and 114-inch focus; a 6-inch Dallmeyer camera 40-inch focus; a portable telescope for observing contacts; a concave grating spectrograph; a chronospectrograph; polariscopic apparatus; meteorological apparatus.

Each station will be supplied with instruments for determination of time. Where telegraphic facilities are available the stations will be supplied with chronographs and portable transits for the determination of the difference of longitude.

The location of the Naval Observatory stations can not be finally settled until the local conditions are personally examined, but those mentioned above are especially indicated as desirable stations to occupy.

C. M. Chester.
Rear-Admiral, U. S. N.,
Superintendent Naval Observatory.

SCIENTIFIC NOTES AND NEWS.

By order of the president of the American Association for the Advancement of Science the spring meeting of the council was called to meet at the Cosmos Club, Washington, on April 20, at 4:30 P.M.

The following appropriations have recently been made from the Rumford Fund of the American Academy of Arts and Sciences: To Professor Charles B. Thwing, of Syracuse University, $150 in aid of his research on the thermo-electromotive force of metals and alloys; to Dr. Harry W. Morse, of Harvard University, $500 in aid of his research on fluorescence.

Sir William Ramsay has been elected a member of the Atheneum Club under the rule for the annual election of nine persons 'of distinguished eminence in science, literature, the arts, or for public services.'

The University of Edinburgh has conferred its doctor of laws on William Watson Cheyne, C.B., professor of surgery, King's College, London; John Hughlings Jackson, M.D., F.R.S., London; Augustus D. Waller, M.D., F.R.S., director of the physiological laboratory, University of London; Colonel Sir Frank E. Younghusband; and George A. Gibson, professor of mathematics, Glasgow and West of Scotland Technical College.

The German Society of Apothecaries will commemorate the hundredth anniversary of the discovery of morphine by Dr. Seetürnerby, erecting a tablet on the house in which he lived at Hamelu, Hanover.

Professor Hugo Münsterberg, of Harvard University, has declined the offer of a chair of philosophy, tendered to him by the University of Königsberg.

President Eliot, of Harvard University, who has been in Europe since the latter part of January, expects to arrive in Boston on April 22.

Professor Edwin J. Conklin, of the University of Pennsylvania, has gone to the Marine Biological Station of the Carnegie Institution at the Dry Tortugas to carry on research work.

Professor E. B. Van Vleck, who holds the chair of mathematics at Wesleyan University, will spend next year abroad.

Dr. C. J. Martin, director of the Lister Institute, London, has been sent to India to investigate the plague. It is understood that with several bacteriologists he will carry on work at Kasauli. The deaths from the plague in India average more than 30,000 a week in spite of all efforts which have been made to check its ravages.

Dr. Oliver L. Fassig, associate in meteorology at the Johns Hopkins University and local director of the United States Weather Bureau, will shortly leave as the representative of the Weather Bureau and of the National Geographic Society of Washington, to search for the Ziegler exploration party, sent out in 1903 to find the North Pole.

Dr. W. C. Farabee, of the anthropological department of Harvard University, will conduct an expedition to Iceland during the present summer. Professor T. A. Jagger has given up his proposed expedition to the island.

Professor U. S. Grant, of Northwestern University, and Professor R. S. Tarr, of Cornell University, are among those who will carry on work in Alaska during the present summer under the auspices of the U. S. Geological Survey.

Dr. J. Paul Goode, of the University of Chicago, spent the Easter vacation week in a tour of the leading cities of Kentucky, making addresses in the interest of forest conservation.

Reuter's Agency is informed that Major Powell Cotton is making satisfactory progress with his expedition from the Nile to the Zambesi, on which he started in December last. The explorer, who is in excellent health, was leaving the Lado *enclave* for his journey into the Congo forest and towards the Zambesi at the end of February. He has secured specimens of most of the species of game to be found in the district, and has preserved complete skins of both elephant and the rare northern white rhinoceros. Of the latter, one specimen only has ever reached Europe.

PROFESSOR HANS MEYER, of the University of Vienna, has accepted the invitation to deliver the Herter lectures at Johns Hopkins University on October 5 and 6. His subject will be, 'The Physiological Results of Pharmacological Research.'

THREE lectures, followed by demonstrations in the grounds, will be given at the New York Botanical Garden to children of the public schools of the Bronx during April and May. The lectures will be given by Dr. Marshall A. Howe, Mr. George V. Nash and Dr. N. L. Britton. They will be repeated three times.

THE Civil Service Commission announces an examination at Washington, on May 17, to fill a vacancy in the position of administrative biologist, at $2,500 per annum, in the Division of Biological Survey, Department of Agriculture. The applicant should have had ample experience in scientific and administrative affairs and be capable of critically examining reports submitted for publication, and sufficiently familiar with the United States and with its mammal and bird faunas to enable him to exercise general supervision over the scientific and economic work of the Biological Survey, including the mapping of the geographic distribution of species.

MR. BENJAMIN FERGUSON, a lumber merchant, has bequeathed $1,000,000 to the Art Institute of Chicago, the income of which is to be used for the erection of statues and monuments in the city.

THE New Mexico legislature has passed a law authorizing a geological survey of the state; the appropriation is $6,000, and is to be expended under the direction of the New Mexico School of Mines at Socorro.

MR. ANDREW CARNEGIE has given $150,000 for a library building at Springfield, Mass.

THE Astronomical Observatory built by the late Dr. Henry Draper at Hastings-on-Hudson in 1860 and used by him for his researches until his death in 1882 was destroyed by fire on March 31. The telescopes and other instruments were removed to Harvard University in 1886, where, under the direction of Professor E. C. Pickering, Mrs. Henry Draper established the Draper Memorial Fund, but photographic negatives and other material of historic interest have been destroyed.

THE American Physical Educational Association has been meeting during the present week at Teachers College, Columbia University.

THE membership of the New York Academy of Medicine has reached the limit of one thousand, and now, for the first time, there is a waiting list.

THE Harpswell Laboratory of Tufts College, established at South Harpswell, Maine, in 1898, to afford opportunities for the study of the northern marine fauna and flora, will be open in 1905 from June 12 to September 9, the regular courses of instruction beginning July 3, and continuing for six weeks. In addition to regular courses of instruction the laboratory offers its facilities to a limited number of persons who are able to carry on investigation without assistance. While not agreeing to collect material for their researches, the laboratory will aid them in this respect so far as possible without interfering with its other work. Seven private rooms are available for investigators. All communications concerning the laboratory should be addressed to the director, Professor J. S. Kingsley, Tufts College, Mass.

THE Belgian government has recently appointed a committee, composed of cabinet officers, members of parliament, financiers and industrial leaders, for the purpose of organizing an international congress, to be held at Mons in the latter part of September, 1905. The object of the congress is to discuss commercial economics, industrial development and progress, facility of communication, opening and civilizing new countries, instruction, statistics, customs, policy, maritime questions and questions concerning the civilizing effects of expansion and the means and power of expansion in general.

UNIVERSITY AND EDUCATIONAL NEWS.

DR. EDWIN A. ALDERMAN was installed as president of the University of Virginia on April 13. It was announced that in addition to the conditional gift of $500,000 from Mr.

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SCIENCE

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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 28, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

LIFE AND CHEMISTRY.*

As I look into the eyes of those before me, I can not but have the feelings of Moleschott in his address at the reopening of the University of Rome when he found himself 'in the face of an audience whom he had nothing to teach, but from whom he had much to learn.'

An imposing knowledge of the distinctions attained by my two distinguished predecessors, perhaps should be depressing; for it is no longer an investment here to forge ahead, but an investment to keep up. On the contrary, their unseen presences stand not as spectres, but as gracious good guardians.

It becomes necessary in the outset to confess to an inner consciousness, that we know. *How* we need not consider for the present further than that the internal thought-centers, association or sense-centers take impressions from the external world and transform them into presentations, which automatically, as it were, frame themselves into concepts. The 'ultimate nature of reality' is not of immediate moment.

Doubtless, man from his earliest experience has speculated on the origin and perpetuation of life, that is, nature. This period is no exception. President Jordan has written, 'whatever else may be said of it, this is certainly the age of deliberate scrutiny of origins and destiny.'

Kant, among many things, wrote 'Only

* Inaugural lecture on the assumption of the head professorship of chemistry in the College of the City of New York, February 28, 1905.

in experience is there truth.' And Haeckel, in his persistent advocacy of the great monistic system, based upon the unity of nature and the unity of science, has asserted, 'All natural science is philosophy, and all true philosophy is natural science. All true science is natural philosophy.'

The great pile at a distance presents itself to the mental perspective in barest outline. As the imaginer draws nigh, the multitudinous variety of the structure is limned on the intellectual horizon. The enormity of the edifice is overmastering. "The larger grows the sphere of knowledge, the greater becomes its area of contact with the unknown." Various crafts must needs arise to disentangle its intricacies.

Numerous subdivisions of natural science have resulted. Each gives more and more to its specialty. At times, in the close scrutiny, the investigator is so near that he fails to grasp the whole and see their relationship. It is unfortunately a fact, as Pearson says, that 'no man whose nose is always on the details of observation is a safe fact-gatherer, while no one whose head is too high above such necessary drudgery is a safe generalizer.'

The complexity of nature seems boundless. "Boundless inward in the atom; boundless outward in the whole."

Biology is the science of life. Elsewhere I have asserted that biology is the application of physics and chemistry to living matter. It requires little knowledge to show that these divisions of science are purely arbitrary. After all, they are not so much divisions or parts of science, as they are simply different methods of looking at the same mystery. While Laplace in his mechanical conception of the world asserted that the progress of nature could be foretold for all eternity if the masses, their position and initial velocities were given, Mach has well said, "Physical science does not pretend to be a complete view of the world; it simply claims that it is working towards such a complete view in the future. The highest philosophy of the scientific investigator is precisely this toleration of an incomplete conception of the world and the preference for it rather than for an apparently perfect but inadequate conception." It is not, therefore, gross temerity which prompts the chemist to give thought to the relations of life and chemistry, for life is chemistry, chemistry applied. It may border on rashness, however, to give utterance to those thoughts, as masters have lost themselves in such contemplations.

> Chemistry has taught man to know aright the requirements of mother earth, the conditions which must be fulfilled to ensure bountiful crops. No longer need virgins be sacrificed to the genius of maize, as was done by some tribes of American Indians, in order to plead for a generous yield of the life-sustaining cereal. (Wiechmann.)

While science appeals to us from a most practical point of view and especially is that true for chemistry, it is not to that phase of the subject that I desire to direct your attention.

Before Darwin there was more anticipation, but some interpretation, of nature. Although preceded by Heraclitus and Empedocles, Aristotle appears to have laid the foundations of biology. For fifteen centuries, with limited exceptions, they were unbuilt upon. Then there began the gradual growth of the scientific renascence, culminating in the Encyclopædists. Science, however, does 'not consist solely in the description of observed facts.'

Biological history for our purposes may be schematized as follows: organism, organ, tissue, cell protoplasm. Altmann's visible granules, Flemming's threads, Frommann's skeleton, Bütschli's honeycomb, according to Haeckel, are but secondary products of the differentiation of the plasma.

Latterly, Osler has said, "Around the nature of cell-organization the battle wages most fiercely, and here again the knowledge of structure is sought eagerly as the basis of explanation of the vital phenomena. So radical have been the changes in this direction that a new and complicated terminology has sprung up, and the simple undifferentiated bit of protoplasm has now its cytostome, cytolymph, caryosome, chromosome, and with their somacules and biophores. These accurate studies in the vital units have led to material modifications in the theory of descent."

It is unnecessary for us to trace fully the history of the idea of 'spontaneous generation,' which has persisted for twenty centuries. The story has been recommended 'to the psychological historian as a labyrinth of error, with glimpses of truth at every turn.'

Leeuwenhoek, by using a crude microscope, showed 'spontaneous generation' to be only apparent, not real. A memorable scientific battle was fought over parasitic animals. "Adam was said to have contained all the human parasites from the first—a state hardly consistent with Edenic bliss." Now *Darwinismus* makes such assumptions useless.

Pasteur almost proved that all 'life comes from preexisting life.' But Tyndall and Dallinger learned that in many cases 'young and immature germs could survive the boiling temperature, growing and propagating themselves when the liquid subsequently cooled.'

Life was in every case traced to other life. Its origin remained a profound mystery. Man beat in every direction hoping a door might open. Kelvin suggested that germ life may have been a meteoric passenger from otherwhere. Allowing such arrival gave no answer to the question as to the origin of the life found on the meteorite. Helmholtz, in advocacy of this 'cosmozoic hypothesis,' said, 'Organic life either came into existence at a certain period, or it is eternal.'

Just a few years ago Professor Rücker in his address before the British Association said: "Perhaps the chief objection which can be brought against physical theories is that they deal only with the inanimate side of nature and largely ignore the phenomena of life. It is, therefore, in this direction, if any, that a change of type may be expected." Before then the Count de Gasparin wrote in the *Journal des Débats*, 'Take care; the representations of the exact sciences are on their way to become the inquisitors of our days.'

Projected as we are upon the stream of life, we endeavor to learn first how it continues and thus reach its source. This is not an altogether illogical method; quite the contrary, as it rests upon the great principle of true inductive reasoning from experience to cause.

There are two great principles upon which the philosophy of nature now rests. They are the doctrines of the conservation of matter and the conservation of energy. These are dependent upon our conception of length and time, measured by arbitrary standards. A metallic bar is the former unit. The revolution of the earth gives us a day, which may be shorter or longer according to tidal friction. Or the recurring seasons give us the year unit, depending upon the course described by our relation to the sun. We are aware of necessary calendar changes as a result. And yet Cavendish's idea of science was measurement!

These tenets have recently been brought into question as a result of the investigations pursued in the laboratory where Newton, Clerk-Maxwell, Stokes, J. J. Thomson and Rutherford worked. Before the inter-molecular phenomena are understood, the marvels of the intra-atomic physics have amazed a decade accustomed to wonders.

One form of matter may be converted into another. Accepting for the sake of argument that this transformation may even take place among the elements, and it is by no means necessary that we do, we may abide a while longer with the idea of the discontinuity of matter. Our atomic base may be shifted, which is just as well, but with our conscious powers and experimental observations, we are not yet ready to say that something is made up of nothing. Matter occupies space and has weight.

We may, therefore, for the time being disregard the metaphysical energism of Ostwald, to revert to it again. Through the basic studies of thermo-dynamics by Willard Gibbs we arrive at the equilibrium in physical and chemical systems. Lord Kelvin, considering the dissipation of energy, reached the logical conclusion that permanent equilibrium occurs only when availability is a minimum. A point I desire to make, particularly, here is that the limiting brain of man finites the infinite in his experiments or actual experience.

We know life only in its association with matter. Yet it is not matter, it occupies no space, has no weight, as we know gravity. The dead cat is under the same gravitational influence as before the loss of the traditional nine lives. A copper wire weighs the same whether the current pass or not. A bar of iron neither gains nor loses in mass when it is magnetized.

These latter can do work; they have energy. The analogy—a dangerous thing not alone in science—is striking.

We know no matter without energy. Do we know any energy except through its manifestation on matter?

The brilliant metaphysical teachings of Ostwald demand our utmost consideration, whether we give allegiance or not. In abstract, his reasoning asserts that we are aware of matter only through energy. Matter is an assemblage of energy systems; there is no matter. All resolves itself into the mechanics of energy. Life, electricity, heat are elementary energy systems, having definite capacity and intensity, as chemical entities with their equivalents represent our atomic conceptions.

Is life energy? We know of no manifestation of life without evidence of energy. It does not necessarily follow that all energy is accompanied by life demonstrations. I am not sure but we shall yet see that energy manifestations include life.

A stone rolling from an elevated position has kinetic energy by virtue of its motion. If its progress be checked by an obstacle in its path the translational energy is converted into heat energy. One form is converted into another. There is no loss of energy. If the obstacle be removed the body continues its descent. An impulse was necessary. At rest it possessed potential energy by reason of its position. To acquire that position equal muscular or other form of energy was necessary. There was no gain of energy. That depended upon the combustion of the tissues, a chemical process, chemical energy. We are accustomed to the idea that all energy may be measured either as gram-centimeters or as foot-pounds, merely convenient units into which other terms are easily reducible. Considering life from the energy point of view Hibbert says, 'All other forms of energy can be measured in foot-pounds of work.' Therefore, life is not energy.

I am not altogether sure that we have measured the energy of the Röntgen rays. The charge on the cathode particle was the recent fundamental determination guiding J. J. Thomson. Rutherford has just succeeded in learning the positive charge on the alpha-particle from radium. These are forms of energy, the nature of which in part only has lately become known. Certainly it is suggestive that refinements may possibly in time give us measurements of a life-energy!

Energy activities are not seldom actuated, directed and facilitated by certain inorganic or lifeless things. These substances, which cause things to happen with acceleration, are known technically as catalytic agents. Sulphur dioxide and oxygen when mixed appear to remain so. The presence of platinum brings about a rapid union. Platinum and other finely divided metals convert alcohol into acetic acid, a process for a long time attributable only to the influence of living organisms.

In 1828 Wöhler bore down the barrier between inorganic or dead matter and organic substances, supposed to result solely through the activity of vital forces. It is now well known that certain complicated organic compounds of undetermined composition, as the enzymes, act as catalytic agents. Complex sugars are broken down into simpler sugars. Complex fats are built up from simpler constituents. Although the action may be attributed in part to chemical reactions, the details of the progressive and continuous action of these agents are as yet little understood and are demanding much attention at present.

When complex carbon compounds are burned with oxygen, heat is produced. The heat of this chemical action is simply the resultant of the energy absorbed and given out. We have so far secured no way of measuring absolutely chemical affinity, as we may measure heat in calories, for example. When certain organic bodies are mixed with oxygen without the presence of a living thing, or one of these exciters, no evidence of chemical energy, within reasonable time, has been noted. However, we are by no means sure that there are no energy manifestations. The exciter facilitates or accelerates its manifestation. The oxygen carried into the lungs reacts throughout the animal tissues. We are not yet ready to say how this is. It is not unfair to assert, however, that the energy binding the oxygen atoms together in the molecule is perhaps overcome in part through the organic catalytic agents present. We are aware of cases of suspended animation in which the organs returned to the performance of their functions.

The term catalyzer has been confined to substances and not used in reference to energy agencies alone. Grove considered the facts of catalysis dependent upon voltaic action, 'to generate which, three heterogeneous substances are always necessary.' We know that ultra-violet light will quicken the union of hydrogen and chlorine. By simply holding metallic tin at a definite temperature (20° C.) the whole crystalline structure is altered from tetragonal to rhombic. This does not occur at any other known temperature, requires no foreign substance, and we are unable to measure the actual energy involved. It is not unfair, therefore, to suggest that energy is converted under certain conditions into some transformation we have not yet learned to measure. Equally must it be true that under conditions this unmeasurable form of energy is transmuted into a measurable variety.

To the supporters of the doctrine of vital force, to quote Rücker again, "the principle of life was not a hidden directive power which could, perhaps, whisper an order that the floodgates of reservoirs of energy should now be opened and now closed, and could, at the most, work only under immutable conditions to which the living and the dead must alike submit. On the contrary, their vital force pervaded the organism in all its parts. It was an active and energetic opponent of the laws of physics and chemistry. It maintained its own existence, not by obeying, but by defying them; and though destined to be finally overcome in the separate campaigns of which each individual living creature is the scene, yet like some guerilla chieftain it was defeated here only to reappear there with unabated confidence and apparently undiminished force.''

We have arrived at the point where we may say that catalysators direct energy or facilitate its activity. So does life. There is much in common.

Going back to Ostwald, matter is an energy grouping. Catalytic agents then must be energy. Life is an agent of catalysis. In frankness, I am unable to conceive matter practically devoid of space occupation any more than I can comprehend energy except in the manner it is presented through its influence on matter. With or without the energetics of the distinguished German scholar, we may hold to the thesis, namely, life is energy or a manifestation thereof.

The experiments of Loeb and Matthews on parthenogenesis through the agency of dilute saline solutions strike at the root of the problem. According to the modern ideas of dilute solutions from the investigations of Faraday, Hittorf, Kohlrausch, Van't Hoff and Arrhenius the ions have electrical charges. Energy is involved, available. Böhn has recently effected similar reproduction through the influence of the rays of radium. These are forms of energy not yet measured.

One were devoid of judgment did he not let it be clearly understood that he appreciates the objections that may be raised, with reason, in opposition to the mechanical, physical, chemical or energy explanation of life. As yet we do not know the constitution of the highly complicated structures of the carbon, hydrogen, oxygen, nitrogen and sulphur compounds of the nucleus; 'chemical matter,' as Neumeister says. The same could have been truly said of the sugars before Fischer's masterly work beginning about a score of years ago. Can we say, having learned the structure, synthesized the nucleus, we shall not be able in the laboratory to give it that impulse which launches it upon a career of reproduction?

Powerful arguments favoring the vitalistic theory, consequently opposed to the energistic, are retention of form through years, reproduction of species and atavistic inheritance of character.

Considering these three in order, it becomes us to show satisfactorily their accordance.

1. Crystals beget like crystals in saturated solutions of the substance. Crystalline growth is by apposition. This is a most familiar phenomenon. Seed, one of the means of nature's reproduction, may remain years, centuries, in vaults, as within the Egyptian pyramids. When subjected to the proper conditions, they sprout and reproduce. Does it not appeal to reason to assume that the sprouting is just as well due to the renewal of the conditions favorable to sprouting, like moisture and proper temperature, as to some germ of life which may have remained dormant for all those years? All knowledge requires hypotheses. If the seed does not sprout then some factor is deficient. A fundamental law of chemistry, based on multitudinous experiments, is that like begets like. Monera, Haeckel's simplest protozoans, either the naked (gymnomers) or those with cell-walls (lepomera), grow by intussusception, or taking of new matter within their interior.

2. Substances to be absolutely the same must not fail in the least resemblance. No two acorns, no two oak trees, no two horses are ever exactly alike, although they may

have many similarities. The structure of the seed, cell or nucleus is complicated, else we should already have learned it. A simple concrete example will serve to illustrate our point. An equimolecular mixture of aluminum and potassium sulphates in water will crystallize in a definite form with a fixed proportion of water. By substituting ammonium for the potassium, we obtain crystals of the same form, with the same molecular proportion of water, yet they are different.

3. It is not difficult, in fact it is a common laboratory practice, to change several factors, either singly, alternately or simultaneously, so that the body first obtained resembles the parent in one or more ways or even not at all; yet on changing back one factor, the grandson resembles the grandfather.

The nucleus is made up of chemical molecules which are dissimilar. We know this much of the albumen molecule, namely, it is very large and complicated, containing from six hundred to a thousand or more of the nineteenth century atoms. They are combined in groups of variable sizes. We have to deal, therefore, with a system of several complicated components. There, doubtless, is a point at which such a system of definite composition may be held in perfect equilibrium through any length of time. If we add energy or take it away, as, for example, heat, the speed of the chemical reaction is altered. The reaction velocity is often reduced one half by a range of five degrees. One hundred degrees may cause it to fall to one millionth. The slightest change in medium, as adding or subtracting water, produces a marked acceleration or retardation in the speed as well as direction of the reaction.

It may be urged that when the nuclei containing these systems are subjected to certain influences, as heat or poisonous substances, they no longer germinate. The vital force was killed. We may also poison the dead catalyzing platinum and it is no longer active. These things are no more than we should expect. When a single factor of a complicated system has been changed, as readily happens through the agencies mentioned, we have no right to ask the same variation in the systems until exactly the same components become concerned in the former way. Ostwald puts it thus: 'As disturbances accumulate, the dissipative actions outweigh the accumulative ones, and the organism goes out of commission.'

With or without the energetics of Ostwald, the reasoning appeals to me. It offers a logical explanation of nature, which is growth. By adding, taking away or varying the components in any system, we may change from a simpler to a more complex system, or *vice versa*.

Bunge, discussing vitalism in physiologic processes, has most eloquently said, "Many centuries may pass over the human race, many a thinker's brow be furrowed, and many a giant worker be worn out, ere even the first step be taken towards the solution of this problem. And yet it is conceivable that a sudden flash of light may illumine the darkness." Science has no impossible boundaries. "Science will continue to ask and to answer even bolder questions. Nothing can stop its victorious career, not even the limitations of our intellect. This, too, is capable of being made more perfect. There is no rational ground for thinking that the continuous progression, development and ennoblement of type which has been going on for centuries on this planet, should come to an end with us. There was a time when the only living creatures were the infusoria floating in the primeval sea, and the time may come when a race may dominate the globe as superior to ourselves in intellectual faculties as we are to the infusoria."

Professor E. B. Wilson, the retiring president of the New York Academy of Sciences, has recently addressed that body upon 'The Problem of Development.' The paper reached me just three days ago. It contains most interesting information on the question of vitalism and mechanism. "In so far as development may be conceived as the outcome of an original material configuration in the nucleus, and a secondary configuration in the protoplasm, it may be conceived as a mechanical process."

This leaves unsolved, however, certain fundamental elements of the problem, for example, 'the manner and order in which the protoplasmic stuffs are formed and assume their characteristic configuration,' or 'how the wonderful phenomena of the regeneration of lost parts in the organism can be explained.' Advances have been made in the solution of the problem on the mechanical basis, hence Dr. Wilson asks, 'by what right does the vitalist demand that we shall adopt his hypothesis for the portions still unsolved?'

I am fully aware that sufficient experimental data have not been obtained to reduce the complicated phenomena to our familiar physico-chemical terms. But as a result of his work on the amphioxus and the dentalium, Professor Wilson remarks, 'It is possible, probable, that living bodies may be the arena of specific energies that exist nowhere else in nature.'

Our survey of the development of natural philosophy has forced upon us one fact, which we can not avoid. It is that man's knowledge of nature has been a growth, an evolution. Just as Francis Bacon thought, truth in science can only be obtained by progressive generalizations. This is true whether we accept the teaching of Darwin or the opposing atavism of de Vries. The means whereby we have gained that extended knowledge are too numerous even for enumeration here. I doubt not the ancient Greek philosophers would have had some merriment in their pity for him who might have suggested the existence of such a substance as the torch of Satan (phosphorus), which was exhibited at the continental courts of Europe.

I am almost overcome with the thought of what I may see, when I consider the immensity of the panorama presented to my venerable predecessors, who happily survive this day. Their half century of greater experience than mine brought them to the light of radium, the penetrating energy of Röntgen, and the phenomena of parthenogenesis. Nations whisper their wonders thousands of miles through the pulsations of energy, which gives life.

Acceptance of this philosophy does not preclude man's reaching a higher state of perfection; nor does it obviate man, as he is, being the highest type this world may ever know. It will depend entirely upon the factors in the systems. When equilibrium of energy has come about, none will be available and life, all life, inorganic as well as organic, will cease. Our world will have come to an end. The degradation will be as imperceptible as the growth. That which is and was returns to that which has been forever—the quiescent ocean of energy in equilibrium, the source and recipient of all life, which we are pleased to name as God. Creation's chorus is stopped, 'hid in death's dateless night.'

"Gone—all gone—like the light on the clouds at the close of day."

Charles Baskerville.
College of the City of New York.

INTERPRETATION OF A WATER EXAMINATION.

Interpretation of a water examination may be considered from two quite different points of view. It may mean the private weighing of evidence by the investigator himself, a procedure which finds expression in his final opinion, or, it may be his attempt, often a desperate one, to make analytical data intelligible to an unscientific audience. The first is, of course, necessary and legitimate, the second is always of questionable policy, and frequently is an undeniable mistake. In former days, when 'standards' were still much in vogue, and when the dictum of Wanklyn, that such and such limits should not be passed in the several items of water analysis, it was indeed a difficult matter, for the analyst to escape from 'explaining' the analytical results to the assembled council of city fathers, and deep was the irritation felt by those people that the figures given could not be explained as clearly as they might have been were the case one involving the composition of an iron ore. Of course, those were times when the chemical data alone were considered sufficient whereon to formulate a pronouncement as to the quality of the water, and it is to be admitted that the chemist himself frequently found before him a very complex problem when he attempted to fit the results of his analysis to the sanitary facts known to relate to the water in question. Bacteriology was as yet undeveloped and its bearing upon the 'sanitary survey' had not as yet seen the light. A sample of water taken anyhow, in any kind of vessel and by anybody, was packed off to the chemist; all knowledge as to where it came from was intentionally withheld and a complete report of its sanitary qualities was confidently expected. The writer once received a sample of a town supply in a two-ounce Lubin extract bottle which still contained some of the original perfumery. Is it to be wondered at that in those early days a good share of discredit was cast upon a water examination? With the advent of bacteriology upon the scene, interest was greatly awakened. The new science promised much, and it seemed that the time had come for very positive and ready answers to the perplexing questions which had bothered us so long. Not so many years ago there met in the city of New York a sizable number of men who had gathered for the purpose of discussing the merits of a chemical *versus* a bacteriological examination of water. Advocates of the two methods advanced arguments in support of their special views and offered illustrations calculated to expose the weak points of their opponents. Unfortunately some remains of that spirit of rivalry still exist; but those who have the widest knowledge of the broad field of 'water supply' readily admit that a competent investigation suitable for determining as to the purity of a city's water service can not be undertaken in the laboratory of either the chemist or the bacteriologist or the microscopist alone, but must be the product of a draft upon the sciences represented by all three of those men, and must, furthermore, include the findings derived from what may be termed the 'sanitary survey.' I am speaking to scientific men, who need no instruction, but perhaps over their heads a few laymen may be reached who need it sadly. And now let it be asked, who are to be classed as the laymen? There is but one answer, to wit, all who have not given special study to this particular subject. The field is so wide, is increasing at so rapid a pace and covers such variety of topics, that even those interested in this line of work have all they can do to keep in touch with the changes taking place about them. The writer well remembers the great risk he once ran of making himself unpopular with the medical profession. While addressing a city council upon the advisability of erecting a special form of filter for the purification of the public water supply, he was interrupted by a councilman, who stated that all of the physicians in the city were opposed to such a plant, and therefore how could the council, composed, as they were, of laymen, run counter to such weight of professional opinion. The answer was simple and emphatic, namely, that upon such a subject the physicians were no less laymen than were the councilmen themselves, and that the paper prepared by them was of no greater worth than it would have been had it been signed by all the lawyers or all the clergymen of the town.

Referring to what has been touched upon above, it is a mistake to underestimate the value of the 'sanitary survey,' by which we mean a thorough knowledge of the source whence a water comes and of the opportunities for pollution, both constant and occasional, to which it may be exposed. In the writer's judgment it is not too much to say that if but one form of examination be possible, the 'sanitary survey' should be the one selected.

Then why not rest satisfied with such examination and permanently exclude chemistry and bacteriology from water cases; and why is not the city engineer an authority competent to express final judgment upon the matter in hand?

In reply it may be said that because of the greatly increased public interest in 'water supply' which has developed during recent years, there has arisen a class of men who have devoted nearly their whole time to the consideration of water questions and who have brought to their aid a sufficiency of chemistry, bacteriology and microscopy to satisfy the requirements of their calling. Such men are, because of their special training and experience, enabled to view the question from more than one side, and their conclusions have, in consequence, greater scope.

Although the writer believes that, taken alone, the 'sanitary survey' is, in the majority of cases, the most important form of examination, he begs not to be misunderstood.

No amount of inspection could be substituted for the bacterial count in testing the efficiency of a filter plant, nor would it be of value in warding off danger to a ground water arising from the presence of an unsuspected cesspool.

As showing the utility of the chemical examination, take the following instance for example:

A well which was most highly prized because of the cool, pleasing taste of its water was found loaded with chlorides and nitrates. Bacteriology gave no indication of pollution, and inspection of the surroundings was spurred into energy by the chemical results alone. Sewage, completely oxidized, from neighboring vaults was found to account for the abnormal items in the analytical results. At the time of the examination no harm was being done, but would the owner of the well be justified in continuing to use such a water and take his chances of the purifying action of the soil being always effective?

It is possible that some objection may be raised to the condemning of a water which shows as its only objectionable feature a chemical evidence of 'past pollution.' If the pollution be truly past and all of the nitrogenous organic matter be represented by nitric nitrogen; and, further, if bacterial examination result favorably, then wherein lies the objection to the use of a water which, although once polluted, has regained its potable qualities? All pure waters, it may be contended, might be classed under such a head; for, after all, we are bound to use water over again sooner or later, contrive matters how we may. All this is true enough, but there is surely a preference as to the length of time between the date of present use and the period of 'past pollution.'

It is true that every time we drink filtered river water we are imbibing a purified sewage of greater or less concentration, and, with a continued growth of our great cities, and the increased pollution of our water-sheds, it would seem that the day is not far distant when a naturally 'safe and suitable' water shall become a thing of the past, and we shall be forced to employ a purified water as our only source of supply.

Let it be remembered, however, that we can control the artificial purifying devices of which we make use, and we can repair them, should they at any time refuse their work.

The case is quite different, however, when our safety lies upon the proper operation of those natural processes of purification which are beyond our power to direct. Such purification, to be satisfactory, must appeal to us as being continuously effective.

We know very well that the raising of water vapor by solar heat will leave objectionable material behind, and we are satisfied that the result is perfect and that it will continue to be so during all time. We also know that the filtering and oxidizing power of the soil is very great, and in general we are willing to pin our faith upon its efficiency. But we can not avoid a feeling of uncomfortable doubt when we note that a small amount of soil has been given a large quantity of work to perform, and we naturally ask, can not the purifying powers of such soil be overtaxed, with the result that our protective filter will become damaged at a point beyond reach of repair? Let an English case be quoted here:

A certain farm-house was notoriously unhealthy. The inmates had suffered at various times from diphtheria and typhoid fever. The water had been examined, and was reported to be satisfactory. Upon examining the premises it was found that there was a water-closet in the house, which was in good order, but where the contents were discharged was unknown. The drains were said to be satisfactory and never to get blocked, and upon tracing them, it was found that they discharged into a dry-steyned cesspool without overflow about four yards from the well, both sunk in the gravel, which here was twenty feet or more in thickness. This well yielded an unfailing supply of water, which was used for all domestic purposes, and upon analysis it was found to be remarkably free from organic matter. It was said to be always cool, bright and sparkling, probably due to its containing a very excessive amount of chlorides and nitrates derived from the sewage percolating into the subsoil and the opinion was expressed that the water was a concentrated purified sewage. This was not believed at the time, but when the cesspool was filled in and the sewage carried elsewhere, the well ran dry. There is no doubt that in this case the same water was used over and over again. After being defiled by the closet, slops, etc., it ran into the cesspool, then filtered through the soil, in its progress the organic matters becoming completely oxidized, and ultimately it found its way back to the well, to be utilized again for domestic purposes. Doubtless at times, possibly after heavy rains, the cesspool contents filtered too rapidly for complete purification to be effected, and this impure water may have been the cause of the ill health amongst those who consumed it.

In this instance, as in the one quoted by the author, the danger signal was held out by the chemical side of the investigation alone, the other methods of inquiry failing to detect any trace of evil.

It would seem that bacteriology deals with the present and that chemistry, besides throwing light upon the past, does to some degree, prophesy what may happen in the future.

Many a water which the bacteriologist has pronounced harmless has been condemned by the chemist because of what it might unexpectedly become at some future time; and, on the other hand, the bacteriologist has time and again shown the presence of unlooked-for pollution when the chemist might search for it in vain.

A good instance of the saving of the situation by a 'sanitary survey' when both chemistry and bacteriology show adverse reports is to be found in the examination of water from a new well or a recently 'developed' spring. Given an old and well-situated spring upon a hillside, the desire of the owner to 'improve' the property with a view of placing the water upon the market will commonly result in a disturbance of the immediately surrounding soil. From a sanitary outlook no harm has been done the water, and one familiar with the situation will offer no objection to continuing its use, but both the chemist and the bacteriologist will secure analytical results which will require to be explained to avoid an adverse report. The writer has seen many cases of this kind.

Wells which are newly dug likewise furnish water of temporary apparent pollution. Distinction must here be made to allow for actual pollution arising from foreign substances being left at the bottom of the finished well. In such instances the evidence pointing to contamination will be found to persist.

The tying up of pollution through the action of frost is another fruitful source of error, if the judgment be controlled by the laboratory data alone. Swamp waters commonly improve in winter, and samples of them will mislead the analyst who is unfamiliar with the districts whence they come. Again, the same agency will solidify surface sources of contamination like those which produced such havoc at Plymouth and New Haven, and the laboratory examination, whether chemical or bacteriological, will, throughout a northern winter, utter no prophecy of what is to be expected during the coming thaws of spring. Nothing short of a thorough sanitary survey can be depended upon in such instances.

The water in a tidal river may be unimpeachable during ebb flow and quite the reverse at periods of flood. How could an analytical examination at the former stage of the stream predict what might be expected at change of tide.

Instances very often arise when public clamor is heard loudly complaining of the taste and smell of water supplied to the people. Much irritation is felt whenever the senses are offended by its physical condition, although gross pollution by pathogenic organisms will be complacently accepted. This tendency of the public to be their own judge as to the suitability and safety of the water they are asked to drink reminds one of the decision of a Mississippi court in a case with which the writer had to do about a year ago. His honor said: "It is not necessary to weigh with tenderness and care the testimony of experts. An ordinary mortal knows whether water is fit to drink and use."

Would that the ordinary mortal did know. Typhoid fever might then be relegated to the list of rare diseases, and much money and many precious lives be saved.

When odors in water occur, what is the analyst to do? By the time the laboratory is reached all smell may have left the sample and great discredit of the scientist will follow should his statement be that the water is sound, when the users thereof know to their sorrow that something is the matter with it. An examination *in situ* is what is needed in cases of this sort, and a view of the storage reservoir backed by microscopic detection of the offending organisms will do vastly more good than any amount of chemical analysis.

A man now deals with the data of water examination in a broad-gauged fashion, feeling that the day has gone by for blind adherence to cut and dried standards. He approaches his decision pretty much as does the medical practitioner frame his diagnosis at the bedside. It may be that the symptoms of the patient do not accord with the description of the disease as found in the books, and the practitioner's attention may be called to those discrepancies by a coadjutor more recently from the schools, nevertheless the breadth of his experience assures the more mature man that his judgment is not at fault and it is experience that is of value in the end.

In conclusion, a word may be pardoned concerning a matter which has received more or less attention of late from the public press, namely, the treatment of reservoir water with copper sulphate for the purpose of destroying suspended organisms. No doubt whatever exists that a sufficiency of the salt will destroy aquatic life, and the amount required to dispose of such as produce objectionable taste and smell is certainly very small.

What the public are anxious about, however, is whether or not the salts of copper are to be classed with those of lead as cumulative poisons. Unfortunately, the answer to that question is not very satisfactory at the present moment. We do not possess as much light upon the point as we should wish.

Copper is eliminated by the liver and kidneys, and some hold that there is a tendency towards an accumulation of the metal in the liver, and that 'elimination is only complete when eliminating organs are sound.' This appears reasonable. On the other hand, we should be reminded that the use of copper sulphate for preventing algal growth is but occasional, and that no necessity is at hand for asking the people to constantly use a water treated with the salt.

A dose of the chemical is administered to the reservoir water; the objectionable plants are killed thereby and no further dosing is required during a considerable interval of time. Let it be noted, therefore, that the amount of copper used is minute, that all of it does not remain in solution, and that its use is not continuous.

As to the employment of copper sulphate for the killing of pathogenic bacteria the case is quite different. Under such conditions the amount of the sulphate required has to be greatly increased, and, what is still more objectionable, its addition to the water supply must be constant, because of the continual presence of the organisms which require removal. It may well be urged that the use of a 'disinfected' water supply would be opposed by the average citizen upon pretty much the same ground that he would object to the use of embalmed beef.

Some modification of the copper process for the killing of disease germs may yet be suggested which will excite the prejudice in the popular mind against 'chemicals' to no greater degree than does the employment of alum in mechanical filtration, but that day is scarcely here as yet. Let it not be forgotten, however, that its use for removal of those algal growths which have given us so much trouble in the past is to be encouraged, and that the authors of the process are deserving of much praise for their contribution to the growing field of 'water supply.'

W. P. Mason.

SCIENTIFIC BOOKS.

A NEW INTRODUCTION TO THE STUDY OF FISHES.

I.

A full fourth of a century had passed since the publication of a general work in English* on systematic ichthyology before a new one appeared to take its place. It was in 1880 that 'An Introduction to the Study of Fishes by Albert C. L. G. Günther' appeared. That work, however, by no means represented the condition of science at the time of its issue, and was replete with errors as well as anachronisms of all kinds. Its author was

* E. Perrier's corresponding portions of his French work (Traité de Zoologie) were mostly published less than a year before (1903), and, if put in the same typographical dress, would cover nearly two fifths more space.

then the custodian of the fish collection of the British Museum as well as 'keeper of the zoological department.' His successor as custodian of the fishes, Dr. George A. Boulenger, is one of the authors of a new work covering practically the same ground as Dr. Günther's. The new work labors under the disadvantage of having no real descriptive title-page. On a bastard title-page it is designated as 'The Cambridge Natural History—Volume VII.,' and on the true title-page it has the following legends apportioned and punctuated as here represented.

Hemichordata
By S. F. Harmer, [etc.].
Ascidians and Amphioxus
By W. A. Herdman, [etc.].
Fishes (Exclusive of the Systematic Account of Teleostei)
By T. W. Bridge, [etc.].
Fishes (Systematic Account of the Teleostei)
By G. A. Boulenger, [etc.].
London
Macmillan and Co., Limited
New York: The Macmillan Company
1904

We are thus compelled to refer to it as the Cambridge Natural History, Volume VII.

The new work, in line with modern concepts respecting the vertebrates or chordates, includes not only the lower types of the vertebrates of the old naturalists, but also the Hemichordata and Urochordata or Tunicates. The old class of fishes of the 'Introduction' is replaced by the three classes for more than a generation past adopted in America, that is, the 'Cephalochordata' (Leptocardians), the 'Cyclostomata' (Marsipobranchs) and the 'Pisces' (Teleostomes or fishes proper).

It may be noted that the names Hemichordata, Urochordata and Cephalochordata are given as terms of subphyla and not as class names. The constituents of the first, for Dr. Harmer, are the 'orders' Enteropneusta, Pterobranchia and Phoronidea, each of which has been considered by some as a class, or, at least, far removed from the others; the second is universally known as the class of Tunicates or Ascidians, the third as the class Leptocardians. The three subphyla thus named are succeeded by another subphylum—'IV. Craniata,' which is divided into two classes: 'Class Cyclostomata,' generally called Marsipobranchs or Myzonts, and 'Class Pisces,' including the Selachians and true fishes, or Teleostomes.

II.

The three 'orders' aggregated as 'Hemichordata' can not be considered to have been proved beyond all cavil either to be closely related or to be true Chordata. The student may find a summary of the arguments respecting the 'affinities of the Hemichordata' at the end of the chapter on the group (pp. 30–32). It is not long since almost all the known species of Enteropneusta were supposed to be referable to one genus—*Balanoglossus*. Now they are distributed among three families and the oldest of them appears under the guise of Ptychoderidæ.

III.

The 'Urochordata' or Tunicata have been elaborated in excellent style by the eminent monographer of the 'class' (Professor Herdman), who has long been known in connection with those animals. In spite of the many different changes and systems that have been proposed by others while he has been actively engaged on the group, he retains practically unchanged the system he employed in the Encyclopædia Britannica (1888) and the *Journal of the Linnæan Society* (1891). It is noteworthy, too, that the name *Cynthia* is still kept, although there is a well-known genus of Fabricius (1808) so termed long before Savigny's genus (1827) was established. That the retention was deliberate and in spite of the facts is evident from a note to the same in the *Journal of the Linnæan Society* (23, 576), where the substitute '*Halocynthia*, Verrill, is [declared to be] merely a synonym.'

IV.

The main structural features of the 'Cephalochordata' are passed under review in an able manner and the latest sources of information made use of. The classification is derived by Professor Herdman from Mr. Walter Tattersall; that author is evidently well informed, but his logical faculty and taxonomic tact will be disputed by some at least.

The 'sixteen species' recognized are grouped under two genera—*Branchiostoma*, 'having biserial gonads and symmetrical metapleura' and *Asymmetron* 'with uniserial (right) gonads and asymmetrical metapleura.' One of the species referred to *Branchiostoma* is the *B. pelagicum*. According to the original describer 'buccal tentacles are absent,' and this statement has been corroborated by all subsequent observers; the last examiner of the species (G. H. Parker, in November, 1904) had an 'exceptionally well preserved specimen' and could 'confirm the statement of most previous writers that oral cirri are absent.' Parker was also, like C. F. Cooper, 'unable to find any evidence of branchial apparatus.' Furthermore, the gonads, though in two rows, 'are often so closely pressed together near the median plane that they there seem to form a single median row.' Surely a species distinguished by such trenchant characters and also distinguished by its pelagic life is entitled to distinction from all its fellows! Owen and the old naturalists generally considered the development of the mouth as 'a longitudinal fissure with subrigid cirri on each side' to be an *ordinal* character of the '*Cirrostomi*' named for *Branchiostoma*. Unquestionably the character is of *generic* value at least, and the form differing so decidedly from it may be ranked not only as the type of a distinct genus (*Amphioxides*), but distinct family (Amphioxididæ). The details of the oral structure, however, remain to be made known.

A flagrant violation of a principle of nomenclature adopted by all learned societies may next be noticed. The name *Asymmetron* has been adopted for all the species 'with uniserial gonads.' Now, *Asymmetron* was not named till 1893, and long before (1876) Peters had named a genus *Epigonichthys* for a species which is believed by the author to be congeneric with *Asymmetron*. If such were the case, the prior name, *Epigonichthys*, should of course have been used for the genus. As a matter of fact, however, some naturalists at least will adopt the names *Epigonichthys* and *Asymmetron*, as well as *Paramphioxus*, for special species or groups of species thrown together in *Asymmetron*. It may be added that the fact that Peters did not appreciate the proper generic characters is not a necessary corollary of the question at issue; he gave the name in connection with an undoubted species and tried to define it.

V.

The 'Craniata,' or rather the pisciform craniates, of course are the chief subjects of the volume, the 'craniata' being equivalent to all the vertebrates of the old naturalists before the recognition of the Branchiostomids. These are considered under two classes, (1) the Cyclostomata and (2) the Pisces. The former, and of the latter the Elasmobranchii or Selachians, and the Ganoids of the Müllerian system, have been treated by Professor Bridge; the Teleosts are summarized by Dr. Boulenger. The elaborate chapters on the anatomical systems and organs are also by Professor Bridge.

On the whole, the chapters on anatomy and physiology are apt and as full as could be reasonably expected in a volume of the series for which it was prepared. That on 'the skeleton' (Chapter VIII.), however, is insufficient in view of the extreme importance of the various osseous elements in the determination of the relationships of all fishes. All the non-teleost fishes might be lost and their loss made good, numerically, by the discoveries of a single year, yet all the space that is devoted to the skeletology of a teleost fish is less than ten pages (pp. 205, 211–216, 237, 240, 246); the species selected, the trout, is also not typical, a far better representative being the one chosen very many years ago by Cuvier and retained by Günther—the perch. The nomenclature of the bones is that current for a number of years past in Europe. Long ago, however, Sagemehl expressed doubt whether a single bone of the fish's skull was really a homologue of any in the terrestrial vertebrates. We fully share in that doubt, or rather belief, but for the present may retain the time-honored names derived from mammalian anatomy for the fish's bones. We can not, however, do so for the elements of the shoulder-girdle; the bones of the trout for which the names scapula and coracoid have been used (p. 240) can not possibly be the homologues of the bones so called in the mammals. The fish bones only became developed as independent bones in those fishes which had originated from a holostean stock and when later specialization in a direction toward the Acanthopterygian type had supervened. To call such bones scapula and coracoid is to inculcate a most misleading concept of piscine morphology and development.

Attention may be called to another statement whose ambiguity will mislead. It is said (p. 252) that 'in some of the wrasses (*Labrus*), the inferior [pharyngeal] teeth are opposed to superior teeth on the upper pharyngeal bones'; experiments show that this sentence may be interpreted to mean that teeth on the superior pharyngeals are exceptional, whereas they are there, as a rule, not only in all Labrids, but in Acanthopterygian and many other fishes. Professor Bridge doubtless knows better, but has been unhappy in the use of words.

Another phase that may perplex the student is the frequent incongruity between the names of fishes referred to in the anatomical chapters and those adopted in the systematic portion of the work, such as *Mesoprion* (p. 235) for *Lutjanus* (p. 663), *Lutodeira* (p. 256) for *Chanos* (p. 294), *Rhombus* (p. 275) for *Psetta* (p. 687), and the like. Such are simple enough, but there are some names which Professor Bridge evidently introduced without knowing what forms were involved. In one place (p. 262), the statement is made that "ciliated epithelium has been found in the intestine of a few species (*e. g., Rhombus aculeatus* and *Syngnathus acus*)." The *Rhombus* here is by no means the same as the *Rhombus* elsewhere, but the *Stromateus aculeatus*. In a second place (p. 275), it is said that 'in *Labrus labrax* there are about sixty' pyloric cæca: now no *Labrus* nor labrid has any cæca and the bass (*Labrax* of Cuvier) has only about five; consequently some other explanation must be found.* Perhaps the statement was based on some hexagrammid, called by Pallas *Labrax,* which has numerous cæca. In a third place (p. 357), we are told that 'stridulating sounds may also be produced by the friction of the upper and lower pharyngeal teeth, as in a species of mackerel (*Scomber brachyurus*)'; there is no mackerel so named, but the fish meant is the 'common horse mackerel (*Caranx trachurus*)' whose relatives are mentioned elsewhere by Professor Bridge (p. 363) as 'horse mackerels (*Caranx hippos*),' and which represent a peculiar family —the Carangidæ (p. 677).

In 'An Introduction to the Study of Fishes' (p. 177), the law was dogmatically declared that 'with regard to size, it appears that *in all* teleosteous fishes the female is larger than the male; in many cyprinodonts the male may be only one sixth or even less of the bulk of the female.' In 'The Cambridge Natural History' (p. 413) it is correctly stated that, 'as a rule, in fishes females are more numerous than males, and *generally* they are larger, but to both statements there are notable exceptions.' It is noteworthy that in the very family of Cyprinodonts of which the males were declared to be very much smaller than the females, there is at least one notable exception in the case of the genus *Mollienisia* (*Mollienia?*), whose males are much larger than the females. Furthermore, the males contrast with the females in brilliant coloration and especially in the greatly expanded dorsal fin. Some other fishes whose males are larger than the females belong to the families Callionymidæ, Gobiesocidæ, Labridæ, Gobiidæ, etc.

In almost all cases, so far as known, the larger size of the male is coordinated with brilliancy of coloration or some other secondary character. In short, the rule seems to be that when the males are brilliantly colored or have other marked secondary characters they are larger than the females.

"The only examples of viviparous fishes,"

* Neither the origin nor cause of the strange confusion of names of two unrelated genera into factitious species has been indicated by Professor Bridge.

it is claimed, "occur in certain families of elasmobranchs, and in five families of teleosts, viz., the Blenniidæ, the Cyprinodontidæ, the Scorpænidæ, the Comephoridæ and the Embiotocidæ" (p. 418). To this list should be especially added the remarkable Zoarcidæ and Brotulidæ combined in a single family under the name Zoarcidæ in the systematic part of the work (pp. 712, 713). Some fresh-water 'Scombresocidæ' of the genus *Zenarchopterus* are also viviparous (p. 638). Certain Cyprinidæ (p. 584), Siluridæ and Cottidæ have also been declared to be viviparous, but the claims have not been quite fully proved.

VI.

The Cyclostomata are ranked as a class, and the two principal divisions, called 'Myxinoides' and 'Petromyzontes,' are designated as 'orders.' Why the old names Marsipobranchii, Hyperotreti, and Hyperoartia should be abandoned is not obvious. The groups, however, are valued in accordance with general current usage, but the last two are of at least subclass rather than ordinal value. The immense gap between the 'Myxinoides' and 'Petromyzontes' is apparently scarcely appreciated by most naturalists, but it was recognized by Ray Lankester a generation ago (1877) in his distinction of the two groups as *classes*. The differences are fundamental and affect all parts and organs. If, for example, Professor Bridge had presented a figure of the auditory organs of *Petromyzon* to compare with those of *Myxine* and other types (p. 388), the contrast could not fail to strike the observer with the requisite knowledge of comparative anatomy to judge of the facts.

The 'Myxinoides' are divided into two families—'Myxinidæ' and 'Bdellostomatidæ.' The 'Petromyzontes' are aggregated in a single family, as usual called 'Petromyzontidæ.' (It should be Petromyzonidæ.) Professor Bridge evidently had an imperfect knowledge of the species. He mentions (p. 426) *Petromyzon* with 'three species widely distributed in Europe,' and just afterwards states that '*Ichthyomyzon, Bathymyzon, Entersphenus* [= *Entosphenus*] and *Lampetra* are also northern forms.' *Lampetra* was originally distinguished for two of the 'three species widely distributed in Europe.' The genera mentioned fall into two primary groups: *Petromyzon, Bathymyzon* and *Ichthyomyzon* in one, *Lampetra* and *Entosphenus* in the other.

The statement is made that 'a new genus and species from Chili has been recently described under the name of *Macrophthalmia chilensis*.' The supposed new type was later (1902) shown by its author (L. Plate) to be simply a stage ('Jugendstadium') in the development of the *Geotria chilensis*. The Petromyzonids of the southern hemisphere differ remarkably from those of the northern in their development as well as otherwise.

VII.

The Elasmobranchii are treated in the old-fashioned style. After the extinct orders Pleuropterygii (p. 436), Ichthyotomi (p. 438) and Acanthodei (p. 440), the now extant types are considered under the orders Plagiostomi (p. 442) and Holocephali (p. 466), and the Plagiostomi are, as of old, divided directly into Selachii and Batoidei (p. 457). Such a division is certainly not expressive of the facts of morphology. There can be no question that the structural differences between the so-called Notidanidæ and Chlamydoselachidæ, on the one hand, and all the other Selachians, are of much more morphological significance than those between the sawfishes of the families Pristiophoridæ and Pristidæ. The Heterodontidæ also appear to be widely differentiated from the others, though not as much so as might be inferred from the old-time allusions to them. In fine, the segregation into (1) Diplospondyli or Opistharthri (Notidanidæ), (2) Prosarthri (Heterodontidæ), (3) Tectospondyli (sharks without anal and rays) and (4) Asterospondyli (other living sharks) appears to comport best with structural and developmental facts as well as with the paleontological record.

The name Notidanidæ has been used just because it is the term employed by Professor Bridge, but it should be discarded. Professor Bridge, apparently, is content to take a name as he finds it without caring whether it is justified by history or not. A number of the names adopted by him would be discarded by those who were willing to obey the codes of nomenclature formed by naturalists whose large experience had convinced them of the necessity of adherence to rules. The persistent violator of such rules places an obstacle in the path of the zoological student and helps to prolong unhappy discord and difficulty. Too often, however, he assumes the attitude of the wolf to the lamb! Examples of family names wrongly used are Notidanidæ (for Hexanchidæ), Scylliidæ (for Scylliorhinidæ), Spinacidæ (for Squalidæ) and Trygonidæ (for Dasybatidæ). The Linnæan name *Squalus* is not used at all and the name *Læmargus,* though at the same time much younger than *Somniosus,* and long preoccupied, is still retained. Of course it may be said nomenclature is of trivial importance and too much has been made of it, but if so why should those who regard it from such a standpoint be obstinate in ignoring rules when adherence need not affect them while it does others?

There is, too, sometimes inconsistency between Professor Bridge's definition of a group and its contents. The family Lamnidæ is said to be composed of "large stout-bodied sharks with two dorsal fins, the first just behind the pectoral fins, the second, which is small, opposite the small anal fin; * * *. Tail with a prominent lateral keel on each side. * * * Branchial clefts very wide." It would thus appear as if Professor Bridge had adopted the family with the same limits that had been given to it by Müller and Henle and American ichthyologists. On looking at its contents, however, it appears that the genera for which the families Odontaspididæ (or Carchariidæ) and Alopiidæ have been framed are referred to it. Yet *Odontaspis* certainly has not the first dorsal 'just behind the pectoral fins,' nor the second or anal 'small' (but unusually large), nor 'the tail with a prominent lateral keel.' Nor does *Alopecias* (properly *Alopias*) agree better. That genus has not the first dorsal 'just behind the pectoral fins,' nor 'the tail with a prominent lateral keel,' nor the 'branchial clefts very wide.' As Professor Bridge had recognized the importance of the differentiating characters in the diagnosis of the Lamnidæ, he should have recognized the families Odontaspididæ (or Carchariidæ) and Alopiidæ by name.

A word may be in place as to *Alopias* and *Alopecias.* It is true that *Alopecias* was the ancient Greek name of the thresher, but Rafinesque thought it was too long and preferred to give a new name to the genus (as he had a perfect right to do); he selected *Alopias,* which can be perfectly and legitimately formed from ἀλωπος and the suffix *-ias.* Müller and Henle first substituted *Alopecias,* but in their great work reverted to *Alopias: Alopias* it should be.

Another notable case of inconsistency is manifest in the treatment of the family 'Scylliidæ' (Scylliorhinidæ). That family is defined as being 'oviparous,' having 'egg-cases large, quadrate,' etc. (p. 446). To it are referred '*Chiloscyllium,*' 'a widely distributed genus,' and *Crossorhinus* (*Orectolobus*). Yet both of those genera were shown in 1901, by Edgar R. Waite, to be ovoviviparous, like most selachians, and referred to distinct families, the Hemiscylliidæ and Orectolobidæ.

VIII.

The non-teleost 'Teleostomi' are disposed of in a somewhat peculiar manner. In the group are included the 'order I. Crossopterygii' (p. 476), 'order II. Chondrostei (Acipenseroidei)' (p. 485), and 'order III. Holostei (Lepidosteoidei)' (p. 495) and from it are excluded the 'subclass III. Dipneusti (Dipnoi)' (p. 505). It appears to be more than problematical whether such an arrangement is the best expression of the present state of our knowledge of the fishes involved. The relationship of the primitive Crossopterygii and Dipneusti was so close that they were confounded in one and the same group (suborder Ganoidei crossopterygidæ) by Huxley, and the gap between the two appears to be much less than that between the Crossopterygii and the nearest related of the existing fishes. Further dissent need not be expressed here. It may be recalled, however, because the discovery is so recent, that George

Wagner (1904)* has recorded the presence of a scaly zone behind the gill cavity, as well as the existence of a pair of minute barbels in *Polyodon*, thus falsifying the characters body 'apparently scaleless' and 'barbels absent' attributed to the family Polyodontidæ by Bridge.

The Teleostei, including almost all the living fishes, have been classified by Boulenger, and the work is worthy of that master of taxonomy and verbal expression of relationships. The group, formerly and generally designated as a subclass, is degraded to ordinal rank, and all the chief divisions, mostly called orders by American and some other ichthyologists, are designated suborders. Of the suborders there are eleven.

A large number of the groups familiar to American ichthyologists are accepted with practically the same limits as are current in the United States, but always with the inferior rank indicated, the orders being designated by Boulenger as 'suborders.' Such are the (1) Malacopterygii, (3) Symbranchii, (4) Apodes, (9) Anacanthini, (10) Acanthopterygii, (11) Opisthomi, (12) Pediculati and (13) Plectognathi. Other suborders have received families which had been ejected from other groups, the suborders thus enlarged being the (5) Haplomi, (6) Heteromi and (8) Percesoces. Another suborder (2. Ostariophysi) has been made to include the Nematognathi and Plectospondyli, the main difference from American practise being in the fusion of the groups, for the relations of the constituents of the so-called 'suborder' have long been recognized, as has the group itself as a 'superorder.'

How divergent this arrangement is from that long adopted in Europe is told by Boulenger (p. 543). "In the classification of Günther, which has been generally in use in [England] for the last thirty years, the Teleosts were divided into six principal groups, of ordinal rank: I. Acanthopterygii; II. Acanthopterygii Pharyngognathi; III. Anacanthini; IV. Physostomi; V. Lophobranchii; VI. Plectognathi. Group [order] I. corresponds to sub-order 6 (part), 7 (part), 8 (part), 10 (part), 11 and 12 of the present work; Group II. to sub-order 10 (part); Group III. to sub-order 9 and 10 (part); Group IV. to sub-order 1, 2, 3, 4, 5, 6 (part), and 8 (part); Group V. to sub-order 7 (part); and Group VI. to sub-order 13.

Some of the modifications introduced into the system are rather startling. The Murænidæ, we are told, differ from the other Apodes in that their dentigerous bones are the palato-pterygoid, the maxillaries being absent, while in the Anguillidæ and others the dentigerous bones are the maxillaries. It is difficult to believe that the dentigerous bones, specialized as they are, should be so different homologically. Exception must also be taken to the reference of the genus *Derichthys* to the family Anguillidæ. That genus has both intermaxillaries and maxillaries, and if it must, perforce, be referred to some former order, it is with the Symbranchii and by no means the Apodes that it should be associated. Anyway, it is the representative of a very distinct family—Derichthyidæ. Another group whose new allocation we can not assent to is the Saccopharyngidæ. The fishes of that family differ markedly from the true Apodes by the absolute want of all opercular and branchiostegal as well as various other bones, and, indeed, have no similarity, except in elongation of body, to the eels. They are more likely to be divergents from some stomiiform stock. From all other fishes, however, they are widely differentiated, and well entitled to rank as the equivalent at least of the suborders of Boulenger—the Lyomeri.

The Comephoridæ are extended to embrace, besides *Comephorus*, the recently described *Cottocomephorus* as well as *Anoplopoma* and *Triglopsis*. Dr. Boulenger expresses the opinion (p. 697) that 'no doubt can be entertained as to the propriety of referring [*Comephorus*] to the neighborhood of *Anoplopoma*,' but after a careful comparison of specimens the reviewer is unable to appreciate a resemblance sufficient to entail approximation in the same family. We may well avail ourselves of the technical character admitted by Boulenger himself; in *Comephorus*, 'the second suborbital is *not produced* over the cheek, a unique exception to the main

* SCIENCE, XIX., pp. 554, 555, April 1, 1904.

characteristic of this division,' and this alone will permit us to keep *Anoplopoma* apart as the type of a distinct family, Anoplopomidæ (or Anoplopomatidæ, if you will), since in this genus the suborbital bone is 'prolonged over the cheek towards the præoperculum' (p. 693).

Triglopsis is unquestionably a typical Cottid and scarcely distinguishable generically from the common *Cottus* or *Oncocottus quadricornis.*

If as to these (and a number of other groups) we must agree to differ, it is gratifying to find that such a self-reliant investigator as Dr. Boulenger, who would rather differ than not, has independently reached the same conclusions as American naturalists in many cases, and has correspondingly abandoned the views so long current in Europe. For example, he has recognized the distinctions and mutual relations of the families of Hemibranchii, Scleroparei, Pediculati and Plectognathi, or at least most of them, which were so long denied by the Güntherian school. There is, too, a notable agreement or approximation to agreement in very many other respects.

The recognition of the high rank of the Discocephali is also a triumph of reason over prejudice and leadership. Its type, *Echeneis,* was declared by Dr. Günther in 'The Introduction' (p. 460) to be closely allied to 'the genus *Elacate,* from which it differs *only* by the transformation of the spinous dorsal fin into a sucking organ'! Gill, after a study of the skeleton (1883) declared that *Echeneis* 'differs *in toto* from *Elacate*' and revived a name given long before by Bleeker. Nevertheless, a man who gave some consideration to osteological characters (F. A. Smitt), in his 'Scandinavian Fishes' (p. 89), thought the 'genus may still lay claim to a place among the Scombridæ, though the family-diagnosis can scarcely notice all such variations'! Boulenger is willing to be influenced by the characters and, therefore, remarks (p. 691) that, 'in spite of a superficial external resemblance to the genus *Elacate,* the sucking-fish bear certainly no affinity to that genus nor to other Scombriformes, as first observed by Gill.'

There is the usual statement (p. 593) in ichthyological works, that the 'only European representative of the family' Siluridæ is the *Silurus glanis.* Over twenty-two centuries ago, however, Aristotle described the habits of a Grecian species differing much from those of the *Silurus glanis,* and Agassiz and Garman have recognized the old *Glanis* as a distinct species closely related to one of Asia (*S. asotus*); it is the *Silurus* (or *Parasilurus*) *Aristotelis.*

The old 'Introduction' purported (very mistakenly) to give the names of all genera supposed to be valid and diagnoses of very many of them. The new work merely gives the names of most of the genera of each family or only the 'principal genera.' None of the genera are diagnosed as many were in the introduction.

Typographical or authorial slips are not numerous. A few of them, however, might perplex the reader and consequently may be noticed here. The name *Anostomus,* properly used for a genus of Characinids (p. 576), also appears as a generic name under Mugilidæ (p. 640); *Agonostomus* is the actual name of the Mugiloid genus. Trichodontidæ is a family name of certain Perciformes (pp. 654, 633); the name appearing for fishes of the suborder Jugulares (p. 704) is merely a slip for Trichonotidæ (p. 706). In the statement that the family Lipogenyidæ 'has lessened the gap between the Lyomeri (Halosauridæ) and Heteromi (Notacanthidæ) of Gill,' Lyomeri (p. 622) is evidently a lapsus for Lyopomi. Lyomeri (p. 622) is properly the name of the group represented by Saccopharyngidæ. *Gnathacanthus* (p. 695) is a slip for *Gnathanacanthus,* the latter meaning exactly the opposite of the former. The Connecticut investigator of the origin of the lateral fins (James K. Thacher) is misnamed 'Thacker' (p. 245).

IX.

The differences between the new ichthyological school of Britain and that of America result chiefly from the different modes of approach to the subject. Dr. Boulenger had long concentrated his attention chiefly on reptiles and amphibians, and the orders of those classes admitted by him are trenchantly separated by well-marked osteological characters. When he entered the ichthyological field he found that orders generally recognized in that class had not the same morphological value as the reptilian ones, and naturally groped around till he conceived he found a corresponding one in the group generally ranked as a subclass—Teleostei. The American naturalists took the orders as they found them left by their predecessors in the field, but a little examination and comparison showed that differences manifest within each of the large orders were of even greater morphological value than those used to differentiate the old orders. Some of those orders were consequently much contracted, as the Malacopterygii, Apodes, Anacanthini, Acanthopterygii and Plectognathi, and types ejected therefrom were set apart as of equal value, such as the Nematognathi, Plectospondyli, Symbranchii, Heteromi, Opisthomi, Pediculati and others. While these may not compare with the reptilian orders, they do with the mammalian and avian. One who has derived his knowledge of the orders of mammals and birds from a comparative examination of their skeletal features, and not from definitions in books alone, must admit that the average orders of mammals are not of greater morphological importance than the orders or 'suborders' of fishes, and that most of the orders of birds are of much less value. Likewise are the most contracted families of fishes of greater morphological value than most of those of birds—espeeially the Oscine birds—and of as great importance as the majority of those of mammals. A desire to establish for the fishes groups comparable with those adopted by the numerous students of birds and mammals has led American students to the narrow limitations of groups manifest in their works. The contrary method isolates ichthyology and gives a false or distorted idea of the significance of the terms order, family and genus. An expression of hope may be pardoned, therefore, that inasmuch as a long established standard for comparison has been adopted by many ichthyologists, others may in time recognize the propriety of accepting such a standard themselves.

The consideration of other differences must be left to other times and other places. Meanwhile we may congratulate European naturalists that the incubus which has long depressed ichthyology in the old world has been, to some extent at least, lifted, and that investigation may now be so directed that it will be profitable to systematic development. It was a bad and unscientific method that has paralyzed science in Europe for these many years, and let us hope that the new work may force it far into the background, if not wholly eradicate it. Let it be distinctly understood that the only sound foundation for scientific ichthyology is a profound *comparative* anatomy, and especially osteology of all the genera. This truth has long been recognized in the United States by some investigators, but it has not yet been appreciated by our museum authorities and in that respect the investigators of the old world and especially of London will for the present have a great advantage over Americans. We may envy our European colaborers, but shall be glad, nevertheless, to admire and avail ourselves of their superior advantages. We shall be grateful, also, for the new light which the coauthors of the 'Cambridge Natural History,' and especially Dr. Boulenger, have thrown and will continue to throw on mooted questions of morphology and classification. We thank them now.

Theo. Gill.

SCIENTIFIC JOURNALS AND ARTICLES.

The March number of the *Botanical Gazette* contains the following papers: John M. Coulter and W. J. G. Land give an account of the gametophytes and embryo of *Torreya taxifolia,* a species localized in eastern Florida, and closely related to *Taxus.* The type seems to be specialized rather than primitive, with a solitary archegonium, remarkably early fertilization, and no 'open cells' in the proembryo. The peculiar 'rumination' of endosperm proves to be due to the irregular encroachment of endosperm upon perisperm. Pehr Olsson-Seffer discusses the principles of phytogeographic nomenclature, urging the gradual evolution of terminology rather than its rigid prescription. Harry N. Whitford continues his discussion of the forest of Flathead valley, Montana. J. C. Arthur suggests a set of simple terms for the spore structures in the Uredinales, whose confused terminology is at present extremely perplexing.

The contents of the *Journal of Comparative Neurology* for March are as follows:

Irving Hardesty: 'Observations on the Spinal Cord of the Emu and its Segmentation.' With four figures.

S. J. Holmes: 'The Selection of Random Movements as a Factor in Phototaxis.'

Walter C. Jones, M.D.: 'Notes on the Development of the Sympathetic Nervous System in the Common Toad.' With twelve figures.

Editorial:—Concerning the Genetic Relations of Types of Action. The Basis for Taxis and Certain Other Terms in the Behavior of Infusoria. The Problem of Instinct.

Isador H. Coriat: 'A Review of Some Recent Literature on the Chemistry of the Central Nervous System.'

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 165th meeting was held March 8, with President Merrill in the chair. The regular program included:

Genesis of Ore Deposits at Bingham, Utah: J. M. Boutwell.

Three types of ore were described: (1) lead-silver ore in lodes, (2) auriferous copper ore disseminated in monzonite and (3) bedded pyritous copper ore in marbleized limestone. The lode ores are believed to have been transported by heated solutions which ascended from a deep-lying magma along northeast-southwest fissures, and to have been deposited mainly by filling, partially by replacement. The disseminated ore was shown to have been formed at a period subsequent to the date of intrusion, partly from the original constituents of the monzonite and partly from copper, gold and other elements introduced by highly heated solutions or vapors. The immense lenticular beds of pyritous copper ore were formed by molecular replacement of contact metamorphosed limestone, partly from elements emitted by the intrusives contemporaneous with their intrusion and partly by subsequent additions from deep-lying portions of the magma after the superficial portions had at least partially solidified. Since these two periods of ore deposition the primary sulphides have been enriched by superficial alteration to oxides, carbonates, sulphates and secondary black sulphides. The complete report on this district which has been prepared by Mr. S. F. Emmons, Mr. A. Keith and Mr. J. M. Boutwell, is now in press and will appear shortly as Professional Paper No. 38.

The Subterranean Gases of Cripple Creek: Waldemar Lindgren.

A brief account was given of the gases which issue in some of the Cripple Creek mines and which as a rule were not encountered until a point below the zone of oxidation was reached. These gases interfere greatly at times with the work of those mines in which they appear and several deaths have been caused by them. It was found that the amount fluctuates according to the stand of the barometer. At low barometer it issues plentifully from the fissures and the porous rocks, and may fill the mine up to the collar. With high barometer the gas disappears and the change may take place very suddenly. The gas as a rule is heavy and accumulates in winzes and shafts. Its temperature appears to be somewhat higher than that normally prevalent in the mine. It was soon found that the amount of carbon dioxide, of which the gas was believed to consist, was entirely inadequate to produce the effects noticed, and analyses show that a great excess of nitrogen is present. A sample from the Conundrum mine was kindly analyzed by the department of chemistry at Cornell University, with the following result:

CO_2	10.22
O	5.7
N	84.1

Mr. W. H. Weed presented a paper on 'An Asphalt Lake near Tampico, Mexico.'

Geo. Otis Smith,
Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 397th regular meeting of the Biological Society of Washington was held February 11, 1905, with President Knowlton in the chair and sixty-eight persons present. Mr. Vernon Bailey exhibited a large mussel shell, about 13 x 8 cm. in size, from Trinity River in southeastern Texas. He noted that the species is a common food for raccoons. He stated that many pearls are gotten from the region mentioned, and that one had sold for sixty dollars. Dr. L. O. Howard called attention to the first authentic record from the Pacific coast of Mexico of the presence of the yellow fever mosquito (*Stygeomia fasciata*) in this region. The authenticity of the record rests in specimens sent to Dr. Howard by a physician.

The first regular paper of the evening was by Dr. Albert Mann on diatoms. The speaker introduced his subject by referring them to the Conjugatæ of the green algæ, and gave several reasons for this systematic position.

He then took up their distribution, stating that they are to be found in all latitudes and all waters, fresh, brackish or salt; that the tropical are the largest and most ornamental, but they are most prolific in individuals in arctic waters. Geologically he placed their first appearance in the Upper or Middle Cretaceous, stating that the claims of Castracane and others of their presence in the coal measures or even lower are inconclusive. Many of the great beds of diatom earth were referred to.

The box-like structure of these algæ was next illustrated by drawings and the elaborate ornamentation of the valves described. Outside of this silica case the organic pellicle, erroneously called a 'gelatinous' sheath, and inside the case the large symmetrical chloroplasts, the cytoplasm, nuclei, vacuoles and oil globules were explained by diagrams.

Under the physiology of the diatoms the speaker explained the normal processes of plant assimilation and stated that their dependence on sunlight precluded their being found living in subterranean waters or deep-sea beds; the limit of the latter he placed at 100 fathoms. Saprophytic diatoms, *Nitzschia putrida* and *Nitzschia paradoxa* were mentioned, the latter semi-saprophytic.

The multiplication of the diatoms by fission was illustrated by several diagrams and the consequent progressive reduction in size commented on. Sexual reproduction, by which the full dimensions were regained, was then described and illustrated, three variations in method being mentioned.

The mystery of diatom movement was discussed and the various theories explained.

Dr. Mann closed his paper by briefly enumerating the economic uses of the diatoms and by a short description of methods of collection. He then exhibited forty-one lantern slides prepared from the negatives of the Hon. A. A. Adee, assistant secretary of state.

The second paper was by Dr. Edgar A. Mearns, on the 'Animal Life of Mount Apo, of the Philippine Islands.' He said, as the result of a month's examination of the solfataric volcano Apo, the giant of the archipelago, its animal life became sufficiently familiar to admit of at least a partial comparison with that of the better explored mountains of Luzon and other islands of the Philippine group. The constituent fauna of Mount Apo partakes largely of peculiar elements, which isolate it not only from the lowlands of Mindanao, but from the highlands of other Philippine islands, and give it a faunal position comparable in importance to that of Monte Data in Luzon and Kina Balu in Borneo. Several of the genera and most of the species of mammals collected on the higher portion of Apo are new to science; and three genera and more than a score of species of birds have been recently added to the Philippine avifauna from Mount Apo. Dr. Stejneger has recently described two new species of frogs and one new Gecko from the speaker's Mount Apo collection.

The 398th regular meeting of the society was held February 25, 1905, with President Knowlton in the chair and thirty-seven persons present. Under Notes, Dr. C. E. Waters referred to the paper of the preceding meeting by Dr. Mann, on diatoms, and to papers by Kramer and White, and asked if it were probable, as suggested, that petroleum was formed from the oil found in the protoplasm of diatoms. This was answered in the negative by Dr. Mann. Dr. E. L. Greene asked if any of the biologists present knew of a Rafinesque other than the one who has contributed so fully to American science. No one replied, and Dr. Greene then stated that in a list of botanical authors, printed at Zurich, Switzerland, in the year 1772, occurs the name of P. I. Rafinesque. He is credited with the authorship of an essay on economic botany, purporting to have been published in 'Memoirs of the Society for Economics,' at Berne, the date of the volume being 1763.

The first regular paper of the evening was by Dr. E. L. Greene, on the 'Earliest Local Flora.' The speaker gave a sketch of the 'Flora Hercynia, a Catalog of the Plants of the Harz Mountains,' by Dr. Joahnes Thalius, published at Nordhausen, Germany, in 1588; a work in which many new plants are named and defined, besides several genera; among these *Alsinanthemum,* a type known since Linnæus by the name of *Trientalis;* also even that more than two centuries later indicated as if new under the name *Eleocharis* R. Br.

The second paper on the program was by Mr. David White, on 'Fossil Plants of the Group Cycadofilices.' This paper was profusely illustrated with lantern slides. Mr. White gave a synopsis of the Pteridospermeæ, describing the more important and interesting anatomical characters of the stems and petioles, and illustrating a number of foliar types and fruits more or less definitely correlated with the other parts of the plants. A number of genera, including *Eremopteris, Triphyllopteris, pseudopecopteris* and *Megalopteris,* were tentatively referred to the pteridosperms, which are to be regarded as comprising the most characteristic plant life of the Carboniferous. Attention was called to the antiquity (Middle Devonian) of one of the types, *Kalymma grandis,* and the consequent probable antiquity of the heterosporous Filices which must have antedated the Cycadofilices.

E. L. Morris,
Recording Secretary.

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

The regular meeting of the section was held at the American Museum of Natural History on Monday evening, March 20. The program consisted of the following papers:

The Sixth Satellite of Jupiter: S. A. Mitchell.

Dr. Mitchell gave an interesting account of the recent discovery of a sixth, and also a seventh, satellite of Jupiter by Professor C. D. Perrine at the Lick Observatory, and described the details of the photographic method by which these satellites were discovered last December and January.

Dr. Mitchell also spoke of the discoveries of satellites of the other planets, including the ninth satellite of Saturn which was found by Professor W. H. Pickering in August, 1899.

A Pocket Form of the New Piezic Barometer: Ernest R. von Nardroff.

The Piezic barometer measures the atmospheric pressure by measuring the *elasticity* of a portion of air. In the small pocket form of the instrument exhibited, a piece of heavy barometer tubing of 3 mm. bore and about 12 cm. long was provided at its lower end with a pear-shaped bulb, having an internal volume equivalent to about 70 cm. length of the tube. At its upper end the tube was provided with a second small bulb containing about 1 c.c. of mercury. Entering into the tube from above was a short tube having at its lower end a capillary opening. Through this tube the mercury was introduced.

In using the instrument all the mercury is brought into the upper bulb by inverting. The instrument is then turned into the erect position, when the mercury enters the main tube a few centimeters, the exact distance depending upon the atmospheric pressure. The less the pressure and hence the less the elasticity of the air, the more the mercury will enter. The mercury stands in the upper portion of the tube and partly in the upper bulb without any tendency to run down the sides of the tube. A scale on the main tube drawn *by comparison* with a standard barometer indicates the pressure.

To understand the theory of the instrument assume the lower bulb replaced by a continuation of the barometer tubing of equal volume. Let b stand for the standard barometer height, m for the length of the thread of mercury entering the tube, and a for the length of the column of compressed air. Then from Boyle's law ($pv = p'v'$) we have

$$b(a+m) = (b+m)a,$$
$$b = a,$$

and hence

$$\Delta b = \Delta a.$$

That is, the divisions of the scale on the Piezic barometer are of the same size as those on the ordinary barometer. However, in practise the upper bulb always contains some mercury after the air is entrapped. The general effect of this is to make $\Delta a < \Delta b$.

The Exhibit of the U. S. Geological Survey Radium Collection shown at the St. Louis Exposition: G. F. Kunz.

Mr. Kunz described the object of and the success of the exhibit, stating that many of the most eminent investigators, including Sir William Crookes and Professor Rutherford, had sent their original material. The collection was shown in an upper hall of the museum. There was also exhibited the Kunz 1,081-pound mass of Cañon Diablo meteoric iron, the largest mass known of this meteoric iron. Mr. Kunz stated that Professor Henri Moissan, of Paris, had discovered in dissolving 183 pounds of this material (Cañon Diablo meteorite), not only crystalline diamonds, but the crystalline substance, carbon silicide, never before discovered as a natural product, but extensively manufactured and used in the arts under the name of carborundum. In view of the many eminent discoveries of Professor Moissan in the field of chemistry and electrometallurgy, as well as in the study of meteorites and of diamond formation, Mr. Kunz suggested that this mineral be named *moissanite* in his honor.

Experimental Research concerning Indirect and Secondary Skiagraphic Rays: L. G. Cole.

The immediate discharge from an X-ray tube consists of two distinct classes of so-called rays—direct and indirect. The direct rays have their inception at the focal point of the anode and radiate in direct lines and are not reflected, but deflected, and do not set up secondary rays, but are absorbed by the tissue of the body in proportion to the amount of solids contained therein.

The indirect rays radiate from the walls of the tube, are projected at various angles, and cause secondary rays in objects with which they come in contact, especially the soft tissue, and give great penetration. The effect attained depends on the amount of current, frequency of interruption and molecular action of glass.

Dr. Cole then described the life history of a tube, stating that definite changes occur in a tube when used, including a crisis, and explained the difference between the action of new and seasoned tubes and the difficulty of exciting very old tubes.

He also gave his opinion of the cause of the purple color of the glass of a tube and suggested that there is a molecular rearrangement of glass similar to that occurring in steel when magnetized. In a new tube the direct rays amount to 30 to 40 per cent., while in some seasoned tubes as much as 75 to 90 per cent. Furthermore, the indirect rays project themselves behind the bones, causing a lack of definition of bones and obliteration of detail of soft parts, while direct rays give detail in soft parts, showing even the blood in the veins.

Dr. Cole, who is skiagrapher at Roosevelt Hospital, will publish his paper in full in the *Archives of the Röntgen Ray Magazine.*

C. C. Trowbridge,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The sixth meeting of the club for the year 1904–5 was held on Tuesday, March 21, at 7:30 p.m. in the physical lecture room, Science Hall.

The first paper on the program, by Dr. R. Fischer, treated the subject 'Food Adulterations and their Detection.' The various methods of adulteration of human foods met with this state, and the methods of their detection, were explained by the speaker, and a large array of choice specimens of adulterated goods were shown which furnished strong testimony to the cupidity of some manufacturers of food articles and, in many cases, to their lack of regard for human health.

The second paper of the evening, by Dr. C. A. Fuller, was on the subject, 'The Dissemination of Typhoid Fever by Oysters.' Outbreaks of this disease have occasionally been traced to infected oysters. Bacteriological examinations of these shell-fish usually demonstrate the presence of bacterium coli. The survey of 3,000 acres of oyster ground in Rhode Island waters showed that both water and oysters from sections within six miles of the outlet of the capital city sewer contained sewage bacteria, while samples taken at a greater distance from the source of contamination were not infected; similar conditions were observed to prevail in a number of the oyster beds on the east coast of the United States.

F. W. Woll,
Secretary.

MEETING OF EXPERIMENTAL PSYCHOLOGISTS AT CLARK UNIVERSITY.

The second yearly meeting of teachers and students of experimental psychology was held in the Clark University laboratory, at the invitation of Professor E. C. Sanford, on Friday and Saturday, March 31 and April 1. At the first session, on Friday afternoon, papers were read by Mr. L. M. Terman, on 'Tests of Bright and Dull Boys'; by Mr. A. L. Gesell, on 'Handwriting and Scholarship'; and by Mr. W. F. Book, on the 'Learning of Typewriting.' The visitors then inspected the laboratory, under the guidance of Professor Sanford, who demonstrated, among other instruments, two devices for the determination of the temporal limen of disparate sense impressions, a rotating-prism color mixer, and an apparatus for investigating the sensible discrimination of purple. Professor A. H. Pierce, of Smith College, next described three researches now in progress in his laboratory; and a paper by Professor Max Meyer ('Auditory Sensations in an Elementary Laboratory Course') was read by Mr. H. C. Stevens, of Cornell University. A discussion followed, in which Professors Pierce, Sanford and Titchener took part. In the evening the visiting psychologists were entertained at dinner by Professor Sanford.

The session of Saturday morning was opened by President Hall, with a paper on 'Some Tendencies and Dangers of Experimental Psychology.' The paper was discussed by Dr. Hylan and Professor Titchener. Adjournment was then made to the physical laboratory, where Professor A. G. Webster demonstrated his apparatus for the measurement of the objective intensity of sound. The last hour of the morning was spent in further inspection of the psychological laboratory, after which the guests enjoyed the opportunity of meeting the Clark University students at a luncheon given by President Hall.

At the afternoon session Professor Bentley, of Cornell University, read a paper on the 'Analysis of Tones,' and afterwards demonstrated his method and certain of his results. The meeting was fittingly concluded by an inspection of the new library building, arranged by Mr. L. N. Wilson. All psychologists know the treasures of the Clark University library, and the willing courtesy of their custodian; and all present on this occasion were delighted with the disposition and conveniences of the library.

It was decided to accept Professor Judd's invitation to hold the meeting of 1906 in the Yale University laboratory.

DISCUSSION AND CORRESPONDENCE.

ALTERNATION OF GENERATIONS IN ANIMALS.

In the February number of the *Botanical Gazette,* Dr. C. J. Chamberlain writes, "After hesitating for several years I have decided to publish my belief that animals exhibit an alternation of generations comparable with the alternation so well known in plants. In short, the theory is this: the egg with the three polar bodies constitutes a generation comparable with the female gametophyte in plants; similarly, the primary spermatocyte with the four spermatozoa constitutes a generation comparable with the male gametophyte in plants. All other cells of the animal constitute a generation comparable with the sporophytic generation in plants, the fertilized egg being the first cell of this series."

In the diagrams employed in the exposition of his theory he indicates that the animal egg by itself and each spermatozoid is comparable to a plant gametophyte. His statements are not consistent, not in accordance with the facts or even with his figures, and it appears that just where he wishes to draw the homology is not quite clear in his own mind.

Our knowledge of animal phylogeny affords no evidence that the gametes, with their reduced number of chromosomes, are vestigial individuals which at one time in their history lived independent of or apart from the animal body. They do not constitute and there is no evidence that they ever have constituted, a *generation* in the life-history of any animal organism. If amphimixis occurs in the life-history of an organism, a reducing division must also occur. The mechanism of reduction seems, in general, to be bound up in two successive mitoses. That the cytological processes of reduction in plants and animals closely approximate a common plan does, by no means, justify the conclusion that the products are of the same morphological value in the life-cycles of each.

Chamberlain says: "To me the comparison seems so obvious that I can explain the previous absence of a theory of alternation of generations in animals only by the fact that the gamete-bearing generation is extremely reduced and is not approached by any gradual series as in plants. * * * I do not claim any acquaintance with zoological literature further than a reading of the latest edition of Wilson's 'The Cell in Development and Inheritance.' Were there any theories as to alternation of generations in animals, doubtless they would have been thoroughly discussed in that book."

That zoologists recognize an alternation of generations in the Hydrozoa and Scyphozoa is a common statement of their text-books. That a theory of antithetic alternation of generations in the life-histories of animals has been propounded by certain zoologists, Beard and Murray,* does not require a knowledge of zoological literature to determine, for it occupies a conspicuous place in a prominent botanical journal as well.

In the course of their discussion Beard and Murray write: "When one seeks in the higher animals for an equivalent of the alternation of generations in plants in the light of recent work on the reducing division of spore-formation, such a morphological mark would only be found in the maturation of the egg and in spermatogenesis. If the process were here a spore-formation, the whole metazoan body, in which it took place, would represent the asexual generation, and any apparent alternation of generations in the life-cycle would be homologous in character, not antithetic."

In speaking of the reduction of chromosomes in the oogenesis of *Fucus*, Farmer and Williams† call attention to this same analogy in the following sentences: "Thus *Fucus*, in this respect, approximates more closely to the type of animal oogenesis than to that which obtains in those higher plants in which the details of chromosome reduction have been followed out. Regarded from the standpoint of the number of its chromosomes, the *Fucus*-plant resembles the *sporophyte* of the higher plants, whilst the gametophyte of the latter, with its reduced number of chromosomes, finds its analogue merely in the maturing sexual cells of *Fucus*."

HAROLD L. LYON.

UNIVERSITY OF MINNESOTA.

* *Anat. Anzeiger*, **11**: 234–255. *Ann. of Botany*, **9**: 441–468.

† *Ann. of Botany*, **10**: 479–487.

SCIENCE AND THE NEWSPAPERS.

TO THE EDITOR OF SCIENCE: Recently three Chicago newspapers (the *Record-Herald*, the *Tribune* and the *Chronicle*) published, without our knowledge or consent, an alleged account of experiments communicated by us to a meeting of physiologists. It is needless to state that this account was quite misleading. We at once sent the enclosed letter to the papers in question. Only one of them (the *Record-Herald*) pursued the fair and manly course of publishing it. The *Tribune* did not deign even to acknowledge receipt of our letter. The *Chronicle* refused to print it, but offered to correct any misstatements in its article, an illusory offer in relation to such a tissue of inaccuracies, and one which we had no desire to accept.

We think it right that the scientific professions should know the attitude which the conductors of some newspapers consider themselves justified in adopting towards scientific workers, and we wish to record in your columns, once for all, that protest which they have not permitted us to make in theirs.

G. N. Stewart,
C. C. Guthrie.

Chicago, April 3, 1905.

Sir:—In yesterday's issue of your paper there occurs a garbled and misleading account of certain experiments communicated by us to a meeting of physiologists of the central states. We are entirely opposed to the discussion of such matters in the lay press. If any reporter was present at our meeting he certainly was there without invitation or permission. We do not know from what source this remarkable piece of copy reached your office. But we can not think the writer has fully considered how injurious such notices may be to the reputation of scientific investigators; and while we entertain the greatest respect for your paper in its proper sphere, we must beg of you in the future to do us the honor of leaving us and our work alone. We trust that you will give this letter the same publicity as the paragraph to which we object.

We remain, yours truly,
(Signed) G. N. Stewart,
C. C. Guthrie.

A MODEST STUDENT OF ANIMAL PSYCHOLOGY.

In the preface to 'The Watchers of the Trails' its author, C. G. D. Roberts, writes:

> The psychological processes of the animals are so simple, so obvious, in comparison with those of man, their actions flow so directly from their springs of impulse, that it is, as a rule, an easy matter to infer the motives which are at any one moment impelling them. In my desire to avoid alike the melodramatic, the visionary and the sentimental, I have studied to keep well within the limits of safe inference. Where I may have seemed to state too confidently the motives underlying the special action of this or that animal, it will usually be found that the action itself is very fully presented; and it will, I think, be further found that the motive which I have here assumed affords the most reasonable, if not the only reasonable, explanation of that action.

On page 221 of the same book the author writes:

> As the raccoons crept along behind the woodshed they smelt traces of a sickly pungent odour, and knew that other marauders had been on the ground not very long before. This made them bolder in their enterprise, for they knew that such depredations as they might commit would be laid to the account of the skunks, and, therefore not likely to draw down vengeance upon the [raccoon's] den in the sycamore.

Maynard M. Metcalf.

The Woman's College of Baltimore,
March 19, 1905.

A NEW FORM OF STEREOSCOPE.

To the Editor of Science: I read with interest Professor Whitman's account of his new form of stereoscope in your issue of April 7. I have described the same type of instrument in Science, Vol. VII., p. 619. I was led to the invention thereof by the instrument called the perspectoscope which mistakenly attempted to get a stereoscopic effect from a single photograph, but in doing so used the convenient device of placing the eyes at right angles to the picture. Using this principle, I made an apparatus with pivoting mirrors which enabled me to throw one of a pair of stereoscopic images into the one eye, and the other into the other, just as Professor Whitman has independently done. I have used this both in combination with weak lenses and without them. I have had such an apparatus in my laboratory for about seven years.

The main advantage of the instrument (its defects are well defined by Professor Whitman) for the psychological student is that it offers a simple means of reversing the perspective without changing the card, throwing the image of the right-hand picture into the right or left eye and correspondingly for the left eye, thus producing a stereoscopic or a pseudoscopic effect; indeed, an intermediate position in which the same view is thrown into each eye is also possible and thus gives the entire range of combinations. The Chicago

Laboratory Supply Company is now making some of these instruments to serve as reversible stereoscopes. In their manufacture the difficulties of projection of the two images to differently situated planes have been encountered, and have been met only by reducing this to a minimum and counting upon the fortunate property of the eyes to ignore or, indeed, to make terms of peace with this discrepancy. I find that this is easy, when an ordinary photograph with no sharp gradations of light and shade is used; but with diagrams the non-correspondence of top and bottom is moderately disturbing. I have not hesitated for purposes of convenience to combine lenses with this reflecting stereoscope; but I shall profit by Professor Whitman's suggestion to see how far the increased proximity of the eyes to the mirrors, which he recommends, will obtain certain of the advantages which I tried to secure by weak lenses. This last variation is a detail of construction in which Professor Whitman's device differs from mine.

JOSEPH JASTROW.
UNIVERSITY OF WISCONSIN,
April 8, 1905.

SPECIAL ARTICLES.

A REVISION OF THE COCCACEÆ.*

THE classification of the bacteria presents peculiar difficulties for several reasons. Morphological distinctions are so slight that physiological characters must necessarily be invoked in order to separate and classify the various organisms, and these physiological characters are often variable. Pathogenicity may be taken as a type of those powers of the organism which are easily and profoundly modified by external conditions. On the other hand, there are numerous characters which appear to be extremely constant. Such minute differences as occur in the resistance of different races to unfavorable conditions often remain unchanged through long periods of cultivation. In using these constant characters for classification we are met by another difficulty. Though constant, the differences are very minute, and in studying a number of organisms a perfect gradation is often found between the widest extremes. This is exactly what should be expected from organisms which reproduce only by asexual methods since it is the fusion of independent cells which swamps minor differences producing the uniformity of species among higher plants. With asexual reproduction every minute variation which is inheritable must persist unchanged until some other chance variation occurs. Each such variation means a new and different type of bacterium.

The immense number of generations which may succeed each other in a short space of time makes boundary lines as shifting as they would become among the higher plants if a dozen geological epochs were considered all at once.

Since with unicellular organisms acquired characters may probably be inherited in a higher degree than with other forms, existing races of bacteria will be markedly influenced by the selective effect of environmental conditions, and must bear the impress of their recent history.

There are, therefore, no species among the bacteria in quite the sense in which we ordinarily use the word,—as indicating a group of individuals bound together by a number of constant characters and easily identified by mutual fertility. From one point of view each distinct race might be considered a species; but to apply a name for every grade of difference in each varying character would be impracticable; and such names could have no true specific value. The best solution of the difficulty is the establishment of certain types around which the individual organisms may be more or less closely grouped; but it must be clearly recognized that the groups thus formed are defined by relation to the type at their center and are not sharply marked off at their extremities from the other groups adjacent.

It is impossible to make a natural classification of the bacteria, which shall be a true expression of phylogeny by considering a single character at a time,—for example, by dividing a group dichotomously, first according to mor-

* Preliminary communication. From the Biological laboratories of the Massachusetts Institute of Technology.

phology, then according to liquefaction, etc. Larger groups at least should manifestly be indicated by the collocation of several characters, the association of any two of which markedly strengthens their significance. By applying this principle, five fairly well-marked genera of coccaceæ may be distinguished. Four of these, *Sarcina, Micrococcus, Streptococcus* and *Ascococcus* date back to the early days of bacteriology, although the latter term has fallen into disuse. The mere property of zoöglea formation should not be considered of generic importance, but the few peculiar species which are capable of growing under purely saprophytic conditions and producing large gelatinous masses, are so far marked off from other cocci as to warrant, in our judgment, the retention of Cohn's genus. The genera *Micrococcus, Streptococcus* and *Sarcina* are retained, since in them morphological differences appear to be correlated with differences in biochemical characters or habitat and we have considerably enlarged the definitions of these genera to include physiological and ecological factors. With regard to the genus *Diplococcus* suggested by Weichselbaum for the parasite of pneumonia it should be remembered that any coccus may at times occur in pairs. Yet those organisms which are strictly parasitic and which normally occur only in aggregations of two cells appear to mark a valid group. The morphological character of a genus must never be too rigidly interpreted. It refers to the typical and most commonly characteristic growth forms; and other groupings may at times occur. Therefore, we recognize five genera, based in each case on a more or less constant association of several independent characteristics. The old genera *Merispomedia* and *Staphylococcus* are merely synonyms of Cohn's *Micrococcus,* and *Ascococcus* antedates *Leuconostoc.* Fischer's characterization of *Pediococcus* by regular division into two sections at right angles to each other, rests upon a variable and thoroughly artificial character and probably includes some species of *Micrococcus* and some imperfectly studied species of *Sarcina.*

With regard to the genera, *Planosarcina* and *Planococcus,* founded upon the single characteristic of the possession of flagella there may be more uncertainty. The slow revolution and steady translation observed by Ali-Cohen and Migula as associated with flagella, is certainly a phenomenon distinct from the irregular vibratory and rotary movements noted by other observers, but the resemblance between motile and non-motile forms is so close in all other characters that we can not consider this single property to be of generic importance.

The five genera above mentioned have been discussed first because their characteristics are already somewhat familiar; but in logical order the larger subdivisions should have been previously considered.

The family Coccaceæ, although defined only by the spherical form of the individual, is a thoroughly satisfactory natural group, its members being also marked off in certain physiological characters from individuals of other groups. The family appears to be divisible into two subfamilies. The first, for which we suggest the name Paracoccaceæ (paratrophic cocci), includes *Diplococcus* and *Streptococcus,* parasitic forms which do not develop abundant growth on artificial media and which thrive better under anaerobic than under aerobic conditions, and appear in small cell aggregates of pairs or chains. The second subfamily, the Metacoccaceæ (metatrophic cocci), includes *Micrococcus, Sarcina* and *Ascococcus,* saprophytic or semi-saprophytic types which are aerobic and form abundant surface growths of large cell groups.

The species of the coccaceæ are considerably more obscure. We have reviewed the descriptions of 445 supposedly distinct species given by Cohn, Migula, Flügge, Chester, Sternberg, Lehmann and Neumann, Engler and Prantl, Rabenhorst, Frankland and Woodhead and find a wonderful amount of duplication. Our observations have convinced us that minute differences in morphology, as for example, the distinction between large and small cells or long and short chains, are not sufficiently constant for the erection of species. Again, slight differences in the appearance of colonies on gelatin, which form a large number of German species, vary so markedly, according to the composition of the medium and conditions of incubation, that they may be disregarded. The turbidity and sediment in broth varies with the age of the culture: what is first turbidity later settles to form sediment and those constant differences which do exist appear to be connected with the size of the cell aggregates. Organisms growing in large groups like most of the Sarcinæ produce heavy sediment and often colony-like groups on the walls of the tube, while those in which the cells readily separate exhibit a more diffuse turbidity. The growths on potato and Nährstoff agar are correlated with the general vigor of a particular race and vary markedly. Temperature relations are similarly inconstant and what marked differences exist are correlated with other characters to which we have given weight; for example, the Streptococci, as a rule, thrive best at the body temperature, while the Sarcinæ and many Micrococci grow better or as well at 20°.

There remain then for the establishment of species the relation of the organism to gelatin, its action upon sugars, its pigment production and its power to form nitrites and indol. In regard to all these points much more thorough study is needed. In particular, almost no data exist with regard to indol and nitrite production. By using the first three characters with one or two others which are of importance in special cases we have made a tentative division of the 445 described forms under thirty-one types. A careful comparison of the published descriptions furnished no evidence for more true species and 85 cultures, isolated from various sources, and obtained from the principal American laboratories, which we have studied in considerable detail, fall naturally under some one of the types established. *S. erysipelatos* includes 20 of these cultures, *M. aureus* 11, *M. orbicularis* 8, *M. ochraceus* 5, *M. ureæ* 3, *M. canescens* 5, *M. candicans* and *ventriculi* 2 each, *M. luteus*, *M. cinnabareus*, *M. æthebius*, *S. subflava*, *S. incarnata* and *S. aurantiaca* 1 each. It is very probable that our further investigation will warrant the division of some of these types but we present the thirty-one species below tentatively and subject to later revision. It must be understood as noted above that in all cases the names mark only types, numerous intermediate races existing between.

Family Coccaceæ.

Vegetative cells spherical.

Subfamily 1. Paracoccaceæ (*new subfamily*).

Parasites (thriving only, or best, on, or in the animal body). Thrive well under anaerobic conditions. Many forms fail to grow on artificial media, none produce abundant surface growths. Planes of fission generally parallel, producing pairs, or short or long chains.

Genus 1. *Diplococcus* (Weichselbaum).

Strict parasites. Not growing or growing very poorly, on artificial media. Cells normally in pairs, surrounded by a capsule.

Under *Diplococcus* are three species, *D. pneumoniæ*, Weich., *D. Weichselbaumii*, Trev. and *D. gonorrhœæ*, Neisser—distinguished by the tissue of the host affected, and by the peculiar morphology and staining reactions of the latter species.

Genus 2. *Streptococcus* (Billroth).

Parasites (see above). Cells normally in short or long chains (under unfavorable cultural conditions, sometimes in pairs and small groups—never in large groups or packets). On agar streak effused translucent growth often with isolated colonies. In stab culture, little surface growth. Sugars fermented with formation of acid.

Under *Streptococcus* we find the vast majority of organisms indistinguishable from *S. erysipelatos*, Fehleisen. Two varieties may perhaps be recognized, var. *involutus* Kurth; and var. *tenuis* (new variety), which fails to coagulate milk. Representatives of another species, *S. enteritidis* Escherich, which liquefies gelatin are occasionally found.

Subfamily 2. Metacoccaceæ (*new subfamily*).

Facultative parasites or saprophytes. Thrive best under aerobic conditions. Grow well on artificial media, producing abundant surface growths. Planes of fission often at right angles; cells aggregated in groups, packets or zoöglea masses.

Genus 3. *Micrococcus* (Hallier) Cohn.

Facultative parasites or saprophytes. Cells in plates or irregular masses (never in long chains or packets). Acid production variable.

Under this genus, thirteen species may be distinguished, by the three properties of liquefaction, acid production and chromogenesis, their characters being indicated in tabular form below.

Gelatin Liquefied.

	Acid.	Non-Acid.
Yellow	*M. aureus* (Ros.) Mig.	*M. orbicularis* (Ravenel)
White	*M. pyogenes* (Ros.) Mig.	*M. rhenanus* Mig.
Red	*M. roseus* Flügge.	*M. fulvus* Cohn.

Gelatin not Liquefied.

	Acid.	Non-Acid.
Yellow	*M. luteus* (Schroter) Cohn.	*M. ochraceus* Rosenthal.
White	*M. candicans* Flügge.	*M. canescens* Mig.
Red		*M. cinnabareus* Flügge.

M. ureæ Cohn. Ammoniacal fermentation of urine produced. Gelatin not liquefied.

M. œthebius Trevisan. Ammoniacal fermentation of urine produced. Gelatin liquefied.

Genus 4. *Sarcina* (Goodsir).

Saprophytes or facultative parasites. Division under favorable conditions, in three planes, producing regular packets. Sugars as a rule not fermented.

Under *Sarcina* are eleven species, eight of which are grouped as follows:

	Gelatin Liquefied.	Gelatin not Liquefied.
Yellow	*S. subflava* Ravenel.	*S. ventriculi* Goodsir.
White	*S. candida* Lindner.	*S. pulmonum* Virchow.
Red	*S. rosacea* Lindner.	*S. incarnata* Gruber.
Brown	*S. cervina* Stub.	*S. fusca* Gruber.

In addition three somewhat aberrant species must be recognized—*S. aurantiaca* Flügge, a yellow liquefying chromogen, which unlike the other members of the group, has the power to coagulate milk, with *S. agilis* (Ali-Cohen) Mig. and *S. tetragenus* (Mendoza), Mig., respectively red, and yellowish-white, motile forms. From study of the literature and a few cultures of supposedly motile forms we are inclined to believe that all the truly motile cocci may be classed under these two heads.

Genus 5. *Ascococcus* (Cohn).

Generally saprophytic. Cells imbedded in large irregularly lobed masses of zoögloea, in presence of carbohydrates. Acid usually formed.

Two species are distinguished, *A. mesenteroides* Cienkowski, a non-liquefying form, and *A. mucilaginosus* Migula, a liquefier.

The characters of the species tentatively defined above are still somewhat artificial and may be subject to revision and modification when our studies are complete. It is probable that the liquefaction of gelatin can not bear any very direct relation to phylogeny, since in every genus except *Diplococcus*, and in each subdivision of a genus, a liquefying and a non-liquefying form occur parallel to each other.

Synonymy will be discussed in our full communication later; but we have strictly followed the rules of priority as recognized in other fields of systematic biology.

In reviewing our genera a serial arrangement is at once apparent. *Diplococcus* is strictly parasitic, and commonly produces only aggregates of two cells. *Streptococcus*, also normally parasitic, thrives better, though still not luxuriantly, on artificial media and its typical growth-form is a chain. *Micrococcus* includes both pathogenic and non-pathogenic forms but all grow abundantly on gelatin and agar, in rather large irregular cell aggregates, while some produce acid and some alkalies in milk. *Sarcina* shows further development in the same direction, its growth form being larger and produced by three planes of division, its saprophytic habit being more marked, (no truly pathogenic forms known to exist), with the power of acid production generally wanting. *Ascococcus*, in spite of its slight acid production and chain formation, appears on the whole to form the extreme of this series, since its entirely saprophytic existence and large vegetative growth-forms are far removed from the pathogenic micrococci. The genera above defined seem to mark the important transition stages beginning with such strict parasites as *D. Weichselbaumii* and ranging through the intermediate forms of Streptococci, Micrococci and Sarcinæ to the saprophytic *Ascococcus mesenteroides* at another extreme. We believe that these genera have true phylogenetic significance and represent real groups of organisms having natural affinities.

C.-E. A. Winslow,
Anne F. Rogers.

A CONNECTION BY PRECISE LEVELING BETWEEN THE ATLANTIC AND PACIFIC OCEANS.

ON October 4, 1904, a Coast and Geodetic Survey party, running eastward from Seattle, Wash., met a similar party, running westward, at Hunts Junction, in the southeastern part of Washington. The party running from east to west had started in the beginning of the season from a bench mark of which the elevation had been fixed by a long line run during several seasons and extending westward from the precise level net, composed of many circuits, which covers the eastern half of the United States. As far west as Norfolk, Nebr., the elevations in this net had been checked by completed circuits of precise leveling of the highest grade of accuracy. The joining of the two lines at Hunts Junction completed the first connection by precise leveling between the Atlantic and the Pacific.

The discrepancy developed at the junction was .615 ft. (= 187.5 millimeters), the Pacific being apparently higher than the Gulf of Mexico and Atlantic.

The old question at once arises: is the Pacific at a different elevation from the Atlantic? The discrepancy of .615 ft. must be due either to errors in the tidal observations which furnished the connection with mean sea level, or errors in the leveling, or to a real difference in the elevation of the mean sea surface at the points at which the tidal observations were made.

The three principal connections with sea level concerned are at Sandy Hook, near New York City, at Biloxi, Miss., and at Seattle, Wash. Six years of tidal observations were taken at Sandy Hook and five years at each of the other points. The range in the six annual means at Sandy Hook was .322 ft., and of the five annual means at the stations at Biloxi and Seattle was, respectively, .100 and .204 ft. These ranges are not sufficient to account for the discrepancy of .615 ft.

The shortest line of leveling of the highest grade of accuracy from Seattle to Sandy Hook is 4,600 miles (7,400 kilometers); to Biloxi, 3,500 miles (5,700 kilometers); and to Norfolk, the point at which the line to the westward leaves the thoroughly checked portion of the precise level net, is 2,000 miles (3,300 kilometers).

If it is assumed that the discrepancy (.615 ft.) is simply an accumulated error in leveling and that the rate of accumulation is uniform between Seattle and Biloxi, it is at the rate of one foot in 5,700 miles (.033 millimeters per kilometer). Even if it is assumed that the accumulation all occurred between Seattle and Norfolk, it is at the rate of one foot in 3,300 miles (.057 millimeters per kilometer). This is an extremely small error of leveling.

Another test to determine whether the discrepancy is a possible error of the leveling may be applied. The probable error of the elevations at Seattle, as carried westward from the Gulf and Atlantic, the computation being based upon the discrepancy developed in the circuits in the eastern part of the United States, was ± 76 millimeters. The actual discrepancy is two and one half times this. According to the doctrine of chances, such a discrepancy, two and one half times the probable error, should occur about once in ten times.

Therefore, it is not safe to make the statement that the Pacific is higher than the Gulf and Atlantic; the extremely small discrepancy being well within the possible limits of error of the precise leveling alone, even though it be assumed that the leveling in question is of as high a grade of accuracy as any yet done anywhere in the world.

One is apt to associate observations of such extreme accuracy as this precise leveling with slow progress and high cost. It is interesting, therefore, to note that three thousand miles out of the thirty-five hundred between Seattle and Biloxi have been leveled since the beginning of the field season of 1899, and that the average rate of progress, during the period 1900–1904 (a total of 3,900 miles), with the new type of precise level now in use in the Coast and Geodetic Survey, was 64 miles of completed line per month, for each observer, and that the average cost, per completed mile, was $10, including salaries, transportation and bench marks. Each completed mile was leveled over at least twice, and, in some cases, four or more times. This rate of progress is comparable with that ordinarily secured in wye leveling, which is of a much lower order of accuracy. John F. Hayford.

BOTANICAL NOTES.

RECENT CLASSIFICATIONS OF THE GREEN ALGAE.

The appearance of the fourth edition of Engler's 'Syllabus der Pflanzenfamilien' (whose preface is dated May, 1904, although so far as the green algae are concerned this edition does not differ from the third, dated July, 1902); Blackman and Tansley's 'Revision of the Classification of the Green Algae' (1903); West's 'Treatise on the British Freshwater Algae' (April, 1904), and Oltmanns's 'Morphologie und Biologie der Algen' (July, 1904) enables us to bring together in parallel columns the different systems of classification which they employ (see table). It will be seen that there is little agreement as to the taxonomic grade of the groups. There is even less agreement as to subdivision of groups, and least of all as to their arrangement.

Table Showing Outlines of Classifications of Green Algae.

I. (Engler).	II. (Blackman & Tansley).	III. (West) *	IV. (Oltmanns).
Branch Zygophyceae.	Class *Isokontae.*	Class *Bacillariacae.*	(Class) *Heterocontae.*
Class *Bacillariales.*	Series Protococcales.	Order Centricae.	(Class) *Acontae.*
Class *Conjugatae.*	Series Siphonales.	Order Pennatae.	(Order) Conjugatae.
Branch Chlorophyceae.	Series Ulvales.	Class *Heterokontae.*	(Order) Bacillariaceae.
Class *Protococcales.*	Series Ulotrichales.	Order Confervales.	(Class) *Chlorophyceae.*
Class *Confervales.*	Class *Stephanokontae.*	Class *Chlorophyceae.*	(Order) Volvocales.
Class *Siphonales.*	Class *Akontae.*	Order Protococcoideae.	(Order) Protococcales.
Branch Charales.	Series Desmidiales.	Order Conjugatae.	(Order) Ulotrichales.
Class? *Characeae.*	Series Zygnemales.	Order Siphoneae.	(Order) Siphonocladiales.
	Class *Heterokontae.*	Order Cladophorales.	(Order) Siphonales.
	Series Chloromonadales.	Order Microsporales.	(Order?) Charales.
	Series Confervales.	Order Schizogoniales.	
	Series Vaucheriales.	Order Ulvales.	
		Order Chaetophorales.	
		Order Oedogoniales.	

* The sequence is reversed here so as to facilitate comparison with the other systems. West begins with higher forms and proceeds from these to lower forms.

In comparing these four systems it must not be forgotten that Engler's and Oltmanns's are general, including all algae, while that of Blackman and Tansley's includes the green algae only (excluding the Diatoms and Charales), and West's is confined to British freshwater algae (including the Diatoms, but not Charales). Engler sets off the Zygophyceae, Chlorophyceae and Charales as 'branches' (Abteilungen) coordinate with Archegoniates (Embryophyta Asiphonogama), and Spermatophytes (Embryophyta Siphonogama). These he subdivides into classes, and the latter directly into families. Thus the class Bacillariales contains the single family Bacillariaceae, including all the Diatoms. West divides Bacillariaceae (as a class) into two orders, and these into no less than fifteen families. Blackman and Tansley group the green algae into four classes upon a single character, namely, the cilia on the zoospores and gametes, resulting in four parallel lines (classes). Their 'series' are equivalent to 'orders' in other systems. In West's system the old group Chlorophyceae is nearly the same as Engler's, but with the addition of the Conjugatae. Oltmanns's system, as far as it can be made out from the first volume ('Spezieller Teil'), is much like West's, and includes three larger groups (classes?), the second and third divided into lower groups (orders?) which in turn are divided into families. Oltmanns does not use the terms 'class' and 'order' in the volume at hand, and for this reason brackets are used in the table.

The class Stephanokontae of Blackman and Tansley includes the single family Oedogoniaceae. In their class Heterokontae the first 'series' purposely includes flagellate animals (*Chloramoeba, Vacuolaria, Chlorosaccus* and *Chlorobotrys*) 'since they represent the primitive organisms possessing Heterokontan characters, from which the next two series have been derived.' The series Confervales includes such organisms as *Chlorothecium, Mischococcus, Ophiocytium, Conferva* (of Lagerheim) and *Botrydium*. These authors include *Vaucheria* in a third series, thus widely separating this genus from other Siphonales (in the class Isokontae). This separation is not followed by either West or Oltmanns, who recognize the class Heterokontae as including the Confervales only.

On looking over the outlines of these four systems, that of Blackman and Tansley strikes one as quite the most radical. In order to be understood the position of the authors as stated in their introduction must be borne in mind, as follows: "The most fundamental of these modern conceptions is that which proposes to regard the Algae as consisting of a number of natural classes, phylogenetically independent of one another, more or less parallel in evolution, and each derived separately from the Flagellata. * * * These parallel classes are generally to be distinguished from one another by cytological characters, and more especially by differences in the organization of the zoospore, which is held to retain, throughout each class, most of the characteristics of its primitive flagellate ancestor. The most conspicuous of these differentiating characteristics of the zoospore are the nature of the assimilatory pigments, the character of the chromatophore, and the arrangement of the flagella."

If we exclude the Diatoms and Charales it is found that Engler recognizes 27 families of green algae; Blackman and Tansley, 44; West, 28, and Oltmanns, 37. Clearly, the algologists are no more agreed as to the limits of the families of the green algae than they are as to other points in the classification of these organisms.

THE CUP-FUNGI OF IOWA.

IN a recent number of the bulletins from the Laboratories of Natural History of the State University of Iowa (No. 4, Vol. V.) F. J. Seaver publishes a valuable paper on the 'Discomycetes of Eastern Iowa.' In preparation for this work the author collected 'nearly one hundred species,' of which fifty are now described, the remaining being 'retained for further study,' in the hope that they may appear in a later paper. The species described are all old, the author having wisely refrained from adding new species. The books in which each species is described are cited in connection with each description, the lists resembling lists of synonyms, which they actually are in some cases. The descriptions and notes are good, and the plates (twenty-five in number) are excellent.

SEAWEED STUDIES.

PROFESSOR DOCTOR J. J. WOLFE contributes a cytological study of the red seaweed *Nemalion* to the October number of the *Annals of Botany*, accompanying his paper with seventy-five well-drawn figures. In addition to working out very clearly the structure of the complex chromatophore he finds reasons for concluding 'that *Nemalion* presents the essentials of an antithetic alternation of generations, and that the cystocarp is, therefore, the homologue of the sporophyte in higher plants.'

SARGENT'S MANUAL OF TREES.

THIS important book has just appeared from the press, and there has not yet been time for the preparation of a complete review, which must be deferred until a later issue. It need only be said now that in a neat volume of 826 pages the author has described and figured about 642 species and varieties, which occur in North America north of Mexico. For the first time the American botanist who is especially interested in trees has a portable manual which he can use in every part of the country.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

NATIONAL ACADEMY OF SCIENCES.

THE annual stated session of the National Academy of Sciences was held in Washington April 18–20, 1905.

The following members were present during the session: Messrs. Agassiz, Allen, Becker, Billings, Boas, Boss, Brewer, Brooks, Brush, Cattell, Chittenden, Councilman, Dall, Davis, Dutton, Emmons, Gill, Hague, Langley, Merriam, Mitchell, Morse, Newcomb, Nichols, Osborn, Peirce, Putnam, Remsen, Walcott, Webster, Welch, Wells, White, Wood and Woodward.

The following papers were presented:

Edward L. Nichols: 'The Mechanical Equivalent of Light.'

Dr. H. C. Wood and Dr. Daniel M. Hoyt: 'The Effects of Alcohol upon the Circulation.'

Alexander Agassiz: 'The Expedition of the U. S. Fish Commission Steamer *Albatross*, in charge of Alexander Agassiz, in the Eastern Pacific, Lieut. Commander L. M. Garrett, commanding.'

William M. Davis: 'Resequent Valleys.'

William M. Davis: 'The Geographical Cycle in an Arid Climate.'

W. W. Campbell: 'A Catalogue of Spectroscopic Binary Stars.'

C. D. Perrine (introduced by W. W. Campbell): 'Discovery of the Sixth and Seventh Satellites of Jupiter and their Preliminary Orbits.'

W. K. Brooks: 'The Axis of Symmetry of the Ovarian Egg of the Oysters.'

John C. Branner, of Stanford University; William H. Holmes, of the Bureau of American Ethnology; William H. Howell, of Johns Hopkins University; Arthur A. Noyes, of the Massachusetts Institute of Technology, and Michael I. Pupin, of Columbia University, were elected members of the academy.

M. Henri Becquerel, of Paris, and Professor Paul von Groth, of Munich, were elected foreign associates.

SCIENTIFIC NOTES AND NEWS.

Professor E. B. Frost has been appointed director of the Yerkes Observatory by the trustees of the University of Chicago, in succession to Professor G. E. Hale, who gives his whole time to the establishment of the new Solar Observatory of the Carnegie Institution at Mt. Wilson, Cal.

Dr. William Osler has been elected an honorary fellow of the Royal College of Physicians of Ireland.

The Baltimore correspondent of the N. Y. *Evening Post* states that at the request of Miss Mary E. Garrett, the benefactress of the medical department of Johns Hopkins University, Dr. W. H. Welch, Dr. W. S. Halstead and Dr. H. A. Kelly will meet Dr. William Osler in London in June, to sit for a group portrait to be painted by John S. Sargent.

The Vienna Laryngological Society appointed Señor Manuel Garcia, on the occasion of his one hundredth birthday, to be an honorary member of the society. Professor Chiari, the president, handed the diploma of honorary membership to Señor Garcia.

Professor John F. Jameson, head of the department of history at the University of Chicago, has been offered the post of director of the Bureau of Historical Research in the Carnegie Institution, Washington, D. C. This position is vacant through the return of Professor J. Lawrence Laughlin to the University of Michigan.

Professor Bashford Dean, of Columbia University, plans to spend several months in Japan, where he will continue his studies on the development of the ancient sharks, Cestracion and Chlamydoselachus. He will be the guest of the Imperial University of Tokyo.

Professor H. S. Graves, director of the Yale School of Forestry, who has been in India, is expected to return next month.

Dr. Albert F. Woods, of the Bureau of Plant Industry, has been delegated to attend the Second International Botanical Congress, to be held at Vienna in June, and the International Congress of Agriculture at Rome.

Dr. D. H. Campbell, of Stanford University, will spend next year in an extensive trip through Europe, Africa and Asia. He expects to attend the International Botanical Congress at Vienna and the meeting of the British Association at Cape Town, and hopes to be able to make botanical investigations in the newly opened regions about the Victoria and Zambesi falls. He will then visit Bombay and Ceylon and will spend some time at the Botanical Gardens at Buitenzorg, Java, returning to the United States by way of the Philippine Islands.

Professor Willis L. Jepson, of the botanical department of the University of California, will spend next year in Europe and in the tropics, gathering material for the botanical museum at Berkeley.

Dr. Harry Perkins, of the University of Vermont, has received an appointment for the summer at the Marine Biological Laboratory of the Carnegie Institution at Dry Tortugas, near Key West.

M. Ed. Caspari has been elected president of the French Astronomical Society.

Professor M. Traub has been appointed director of the newly established department of agriculture of Java.

Nature states that the Irish branch of the Geological Survey has been transferred from the Board of Education to the Department of Agriculture and Technical Instruction for Ireland. The work will be carried on under the immediate direction of Professor G. A. J. Cole.

Mr. C. A. Seley, mechanical engineer of the Chicago, Rock Island and Pacific Railroad, delivered an address before the students and professors of Purdue University on April 11. His subject was 'Framing of Passenger and Freight Cars.'

Prince Pedro of Orleans and Braganza, son of the Comte d'Eu, who has already visited that part of Central Asia, contemplates making a fresh tour in Chinese Turkestan.

At a meeting of the Royal Geographical Society on April 10 Lieutenant-Colonel C. C. Manifold read a paper on the 'Problem of the Upper Yang-tsze Provinces and their Communications.'

On March 28, Dr. Fridjof Nansen presented a paper before the Royal Geographical Society on 'Oscillations of Shore-lines'; discussion followed, which was taken part in by Sir Archibald Geikie, Sir John Murray, Admiral Sir W. J. L. Wharton, Mr. Peach, Mr. A. Strahan, Mr. Huddleston, Dr. Mill, Dr. Hull and others.

Nature states that portraits recently added to the National Portrait Gallery include those of Sir Charles Lyell, Charles Darwin and Professor W. Whewell.

Plans are being made to erect a memorial to the late president, Thomas M. Drown, of Lehigh University. It will take the form of a club house for the faculty and students, and will be erected at a cost of $80,000.

Colonel Nicholas Pike, known for his contributions to the natural history of birds, reptiles and amphibia, died at his home in Brooklyn, on April 11, in his eighty-eighth year. A naturalist of the old school, he was the author of interesting notices on the life-history and habits of a number of rare forms, especially among the amphibia. For several years he held the post of American consul in the island of Mauritius, and during this time he collected extensively the local fauna and prepared from the living specimens many colored drawings. Especially noteworthy were the albums of the fishes of the Indian Ocean, some of which illustrated species which were later described by Louis Agassiz. His most extended work was his 'Sub-Tropical Rambles in the Land of the Aphanopteryx.'

Professor Leben Warren, for twenty-seven years professor of mathematics at Colby College, died on April 21, at the age of sixty-nine years.

Mr. H. B. Medlicott, F.R.S., director of the Geological Survey of India from 1876 to 1887, died on April 6, at seventy-six years of age.

We learn from *The Experimental Station Record* that Professor Emerich Meissl, of the Austrian ministry of agriculture, died on February 15 at the age of fifty years. Professor Meissl was for more than twenty years connected with the agricultural experiment station at Vienna, being director from 1886 to 1898. At that time he was called to the ministry of agriculture as an agricultural-technological expert, and was promoted to the charge of a section in the ministry in 1902, which position he occupied at the time of his death. He was widely known among agricultural chemists, having made many contributions upon agricultural analysis, and the chemistry of sugars, milk, and the fermentation industries.

Dr. Georg Meissner, formerly professor of physiology at Göttingen, died on March 30, at the age of seventy-four years.

At a meeting of the council of the American Anthropological Association held in New York on April 15 it was voted to hold a special meeting of the association in Portland, Oregon, during the Centennial Exposition. The members of the council present were: Messrs. Boas, Chamberlain, Culin, Farrand, Gordon, Hodge, Hyde, MacCurdy, Pepper, Putnam, Saville and Smith.

The Experiment Station Record states that it has been decided to locate the new buildings for the Department of Agriculture 106 feet farther west, and to sink the structures 10 feet lower in the ground than was previously planned. This decision is in accordance with the plans of the park commission appointed by the senate some years ago. The details which have been worked out by this commission since the publication of their report make the above changes necessary in order to conform to the general scheme in the matter of the grade and the relative position of buildings. As the excavation for the two laboratory wings as originally located had been completed, these changes will involve some delay in the work.

The King Institute of Preventive Medicine at Guindy was formally opened, on March 11, by Lord Ampthill, governor of Madras.

Mr. Alfred Beit has increased his donation to the London Institute of Medical Sciences from £5,000 to £25,000.

We learn from *The Athenæum* that at a recent meeting of the Institut de France the disposition of 30,000 francs forming the Debrousse legacy was the chief subject of discussion, and M. Poincaré's report recommended the following appropriations: Publication of the 'Tables de la Lune,' 5,000 fr.; *Journal des Savants*, 5,000 fr.; 'catalogue' of the works of Leibnitz, 3,000 fr.; for the study of the 'tuniciers' at Naples, 3,000 fr.; for the work in connection with the installation of the library at Chantilly, 7,000 fr.; and for the introduction of a seismographic apparatus at the Paris Observatory, 3,000 fr. The remaining sum of 4,000 fr. is carried over to next year's account.

The New York Botanical Garden announces the following spring lectures, to be delivered in the Lecture Hall of the Museum Building of the Garden, Bronx Park, on Saturday afternoons, at 4:30 o'clock:

April 29.—'The Indian and his Uses for Plants,' by Mr. Frederick V. Coville.

May 6.—'The Pines and their Life History,' by Professor Francis E. Lloyd.

May 13.—'Botanical Aspects of Deserts of Arizona, California, Sonora and Baja California,' by Dr. D. T. MacDougal.

May 20.—'The Coralline Seaweeds,' by Dr. Marshall A. Howe.

May 27.—'Cuba,' by Dr. W. A. Murrill.

June 3.—'Vegetable Poisons and their Strange Uses,' by Dr. H. H. Rusby.

We learn from *Nature* that at the annual meeting of the Iron and Steel Institute, to be held on May 11 and 12, the Bessemer gold medal for 1905 will be presented to Professor J. O. Arnold. The awards of the Andrew Carnegie gold medal and research scholarships will be announced; and the president, Mr. R. A. Hadfield, will deliver his inaugural address. The following is a list of papers that are expected to be submitted: 'Experiments on the Fusibility of Blast Furnace Slags,' Dr. O Boudouard; 'Recent Developments of the Bertrand-Thiel Process,' Mr. J. H. Darby and Mr. G. Hatton; 'The Application of Dry-air Blast to the Manufacture of Iron,' Mr. James Gayley; 'The Effect Produced by Liquid Air Temperatures on the Mechanical and other Properties of Iron,' Mr. R. A. Hadfield; 'The Cleaning of Blast Furnace Gas,' Mr. Axel Sahlin; 'The Failure of an Iron Plate Through Fatigue,' Mr. S. A. Houghton; 'The Continuous Steel-making Process in Fixed Open-hearth Furnaces,' Mr. S. Surzycki; 'Accidents Due to the Asphyxiation of Blast Furnace Workmen,' Mr. B. H. Thwaite; and 'The Behavior of the Sulphur in Coke in the Blast Furnace,' Professor F. Wüst and Mr. P. Wolff.

An optical convention will be held in London from May 31 to June 3. In addition to papers that will be published in a volume, there will be an exhibition of optical and scientific instruments of British manufacture. Dr. R. T. Glazebrook, director of the National Physical Laboratory is president, and the vice-presidents include Lord Kelvin, Lord Rayleigh, The Earl of Ross, Sir Howard Grubb, Sir W. H. M. Christie and Sir Wm. de W. Abney.

Reuter's Agency is informed that the Duc d'Orléans has organized a North Polar expedition which will leave for the Arctic under the duke's personal leadership next month. For the purpose of the expedition the *Belgica,* the vessel of the recent Belgian Antarctic expedition, has been secured, together with the services of Lieutenant Gorlache, who will again command the ship on the present occasion. The object of the expedition is not to reach the North Pole, and, according to present arrangements, the duke will not winter in the Arctic, although the *Belgica* will be provisioned for the event of her being closed in by the ice. The expedition will leave Norway probably on May 1 and proceed direct to Franz Josef Land, where it is believed that an attempt will be made to push northwards by way of a new channel. The duke's staff will include some French scientists and a number of Norwegian sailors. The duke will sail under the French flag. It is pointed out that as the season is early this year it is probable that the *Belgica* will find little difficulty in gaining the shores of Franz Josef Land. The scheme of pushing up a new channel is not unattended with danger, owing to the force with which the ice pack is driven down by the strong currents. It was owing to this cause that the *Eira,* of Leigh Smith's expedition, was sunk off Cape Flora and that the Duca degli Abruzzi's vessel was also pierced by the ice pack. No doubt a lookout will be kept for the members of the American Ziegler expedition, who are still in the Arctic.

The sundry civil bill for 1906, passed by the last congress, contains an item of $200,000 appropriated to the United States Geological Survey for the purpose of gaging streams and determining water supply. With this sum it is proposed to continue the work of measuring streams in all parts of the United States and of collecting data that will be helpful in promoting water powers and irrigation projects, and valuable in determining the quality of water best suited for domestic and municipal purposes and for manufacturing enterprises. Estimates of the daily flow of important rivers are needed by engineers and investors, as is shown by the many requests for such information received from all parts of the country. It is believed that more than $5,000,000 is annually expended in new projects that are stimulated largely by facts that have been ascertained officially during years of careful observation.

The New York *Evening Post* states that Dr. Otto Klotz, government astronomer of the Dominion of Canada, has been in Cambridge recently, arranging with the Harvard Observatory for a station to perfect his series of longitude observations made in the interest of the Dominion Government. This work was instituted upon the completion of the British transpacific cable a few years ago. Dr. Klotz and his party made longitude connections beginning at Ottawa, at Vancouver, Fanning Island, the Fiji Islands, Norfolk Island, Queensland, Australia and Sidney, N. S. W., where his series met a like series from Greenwich eastward to Sidney. This completed the circuit of the world for the first time in work of this character, an event that culminated actually on the night of September 27, 1903. The work involves the setting up of a firm pier of cement or brick at each of the stations, on the top of which is a point, the longitude of which is determined with the utmost possible accuracy. The observers' clocks at two stations are telegraphically connected during observation, and the error determined with extreme refinement. It is to set up such a pier at Harvard that Dr. Klotz has come, and he has been promised the hearty cooperation of Professor E. C. Pickering and his staff in carrying out his project. This step connects the Canadian transcontinental longitude series at one end with the American series, and ultimately there will be a similar connection established between Vancouver and Seattle, thus completing the loop.

Topographers and geologists of the United States Geological Survey will be at work during the coming summer in the region south and east of Tonopah, Nevada. A party of fifteen or twenty topographers under the direction of Mr. R. H. Chapman will go into the field about the middle of May. They will make surveys for three topographic maps. Two of these maps will be detail maps made by Mr. William Stranahan, one of the Goldfield district, which is 23½ miles southeast of Tonopah, and one of the Bullfrog district, which is about 60 miles east of Goldfield. The Goldfield map will cover approximately 40 square miles and will be drawn on a scale of 2,000 feet to the inch. Triangulation and leveling will be carried from Owens Valley to get control for the Bullfrog map, which will also be drawn on a scale of 2,000 feet to the inch. The third map will be a reconnaissance map of an area about 120 miles long by 90 miles wide, or about 10,000 square miles, south and southeast of Goldfield. It will include Goldfield in its northwest corner. The reconnaissance map will include part of the Death Valley. Levels for the control of all this work are now being carried forward from Mohave by a topographic party under the direction of Mr. R. H. Farmer. It is hoped that there will be an opportunity of running a level line to find the correct elevation of Death Valley. Mr. E. M. Douglas, chief of the western section of topography has computed that the lowest point in the Valley is 450 feet below sea level, which makes it the lowest point in the United States, but the elevation has never been accurately and incontestably determined. Geologic studies in these same Nevada areas will be prosecuted during the summer under the direction of Mr. J. E. Spurr. With the assistance of Mr. S. H. Ball, Mr. Spurr will investigate the general geology of the district covered by the reconnaissance map. Mr. Spurr will also make a special report on the geology of the mining camps in this area. A third report will have to do with the geology of the Goldfield district. Mr. Spurr will be assisted in this last inquiry by Mr. G. H. Garrey.

UNIVERSITY AND EDUCATIONAL NEWS.

A teaching observatory will be established by the Ontario government at the University of Toronto. Dr. C. A. Chant expects to visit the observatories of the United States to study their plans and methods.

The main building of Vanderbilt University was destroyed by fire on April 20.

The Suez Canal Company has voted 50 guineas to be announced at the banquet over which Mr. Chamberlain will preside on May 10, on behalf of the London School of Tropical Medicine, this being a gift in recognition of the school's services in the tropics.

The Geological Department of Colby College, Waterville, Maine, has been abolished by the trustees of the college, the reason assigned for the action being a financial one. Professor W. S. Bayley, who has been in charge of the department during the past sixteen years will therefore sever his connection with the institution at the close of the present college year.

Dr. Charles M. Bakewell, assistant professor of philosophy in the University of California, has been elected to a professorship of philosophy in Yale University.

Mr. Charles W. Brown, of Lehigh University, has been appointed instructor in geology in Brown University.

Fellowships in zoology and entomology at the Ohio State University have been granted respectively to Mr. C. F. Jackson, of De Pauw University, and Mr. W. B. Herms, of German Wallace College, Berea, Ohio.

Professor Walter König, of Greifswald, has accepted a professorship of physics in the University of Giessen.

The council of University College, London, has appointed Sir Thomas Barlow to the Holme Chair of Clinical Medicine, vacant through the resignation of Professor F. T. Roberts.

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FRIDAY, MAY 5, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*SOME PRESENT PROBLEMS IN AGRICULTURE.**

AGRICULTURE is now in a transitional stage. It is passing from the old to the new. It is pupating. The problems are great, and they all have a forward look.

Most of these problems are incapable of solution quickly. They must ripen and mature. They are many; this paper proposes to indicate only a few of them that appeal most to me.

The problems of agriculture are of pressing importance, both to agriculture itself and to the public welfare. They are of two kinds: (1) the technical problems of the business, (2) the problems of adjustment to the affairs of our growing civilization.

The problems of adjustment are of the greatest public concern, because agriculture is our greatest occupation. Agriculture is necessary to civilization. Of all occupations, it employs most men, most capital and is followed in the most places. It probably must always employ from one fifth to one fourth of the people of any self-sustaining nation. There are super-

* Paper read by L. H. Bailey before Department 18, Section on Agriculture, of the International Congress of Arts and Science, St. Louis, September 24, 1904.

numerary, eleemosynary and parasitic occupations; but agriculture is basic.

Other occupations have had their day in the public appreciation. All of them have been born out of agriculture. Tubal-Cain was the descendant of Adam. The greatest of public problems are to come with the rise of the agricultural peoples. Just because it is basic, agriculture has been conservative and patient. Fundamental strata are likely to be azoic; but in great world-movements they are also likely to rise permanently to the top.

The farmer is a wealth-producer. Therefore, his importance in the body politic is primary. He deals with elemental forces. As a wealth-producer, he will come to have a larger voice in the expenditure and waste of wealth in maintaining armaments of war. All his instincts are of peace.

The public problems of agriculture have been slow to gain recognition. The agricultural questions that we customarily discuss are those of the individual farmer. The burden of our teaching has been that the farmer must be a better farmer. Only in recent years has it come to be fully recognized that agricultural problems are of the greatest national and governmental significance. Consider how recent is the Land Grant Act, the secretaryship of agriculture in the President's cabinet, the experiment station act, the origin of a definite farmers' institute movement, the development at public expense of fertilizer and feed controls and other policing policies, the making of liberal grants of public money for specific agricultural uses.

Governmental fiscal policies have been shaped primarily for other occupations, as, for example, the tariff for protection. This is primarily a manufacturer's policy. It matured with the rise of concentrated manufacturing. One of the stock arguments of the protectionist when addressing farmers is that any policy that aids manufacturing interest must indirectly aid them. I am not here to discuss or to criticize tariff legislation, but it is apparent that such legislation is only secondarily of benefit to agriculture. It has been the history of institutions that special and organized interests receive attention before care is given to the common people and the masses.

We have really not endeavored, as a people, to solve our technical agricultural problems until within the present generation. We have escaped the problems by moving on to the west. Thereby we have fallen into the habit of treating symptoms rather than causes, as the policeman does when he orders the offender to 'move on,' and leaves the real difficulty for some one else to solve. Even yet, farmers are moving on to find land that is not depleted and regions free of blights and of pests. The real development of agriculture lies in developing the old areas, not in discovering new ones. When virgin land can no longer be had, scientific agriculture will be born. An isolated island develops something like a perfected agriculture, as one may see in Bermuda or Jersey. The earth is an island: in time it will be developed.

As agriculture comprises a multitude of different businesses, everywhere touching many sciences and having contact with many public questions, so it is impossible for one person adequately to state even its present and pressing questions. I have been in the habit of inquiring of farmers, students and colleagues what they consider the agricultural problems to be. Many of the problems that they have stated to me are temporary, local or incidental. Others are common to many occupations, having to do with the general constitution of society and the general trend of economic events. In this paper I have tried to assemble statements of such questions as appear to me best to illustrate the complex nature of the subject before us. I wish I could give credit to the sources of all the suggestions, but this is impracticable, even though in some cases I have followed very closely the ideas and the language of my informants. I shall be obliged to assume full responsibility for the statements.

THE TECHNICAL AGRICULTURAL PROBLEMS.

In America the so-called problems of agriculture have been largely those of the mere conquest of land. They are the result of migration and of the phenomenal development of sister industries. They have resulted from a growing, developing country. They have been largely physical, mechanical, transportational, extraneous—the problems of the engineer and inventor rather than of the farmer. The problem has not been to make two blades of grass grow where only one grew before, but how economically to harvest and transport the one blade that has grown almost without effort.

During the past hundred years there has been an area of development on the western border of the developed country, and this has been able to compete at an economical advantage with the older area farther east. The price of land has fallen in the east, while it has risen in the west. From 1870 to 1900 we practically doubled our population and doubled our agricultural area. Aside from the geometrical increase in the population, this development has been due to a fertile, level prairie which was practically treeless. Hitherto the axman has hewn his way tree by tree. The development of the area west of the Mississippi River is probably the most remarkable in the history of the world. A second cause for this development is the consolidation of railroads into transcontinental lines; and another is the improvement of labor-saving machinery, of which the self-binding harvester is the most conspicuous example, a machine that first attracted wide attention at the Centennial Exposition in 1876.

To this day the American is a cheap-land farmer. A few minutes on the train from a European city brings one into a highly tilled agricultural country. The other day I took an express train from New York city. It was three quarters of an hour before I saw what I could call a farm, and a full hour before I reached a farming country.

As early as one hundred years ago, a distinct movement for the betterment of agriculture had set in. This movement was largely educational. It was an effort to improve the farmer, quite as much as to improve the farm. Washington was vitally interested in the problem. He wished to have a central board or clearing-house for agricultural information. The full fruition of his hopes came with the establishment of a secretaryship of agriculture in the President's cabinet, in Benjamin Harrison's administration. In 1799 a concrete proposition for the establishment of an agricultural college in Pennsylvania came to an untimely end. In 1821 instruction was given in agriculture in the lyceum at Gardiner, Maine. In 1824 a school of agriculture was opened at Derby, Connecticut. A number of other similar attempts were made previous to the passage of the Land Grant Act of 1862, but of these only the Michigan Agricultural College persists. The gist of the whole movement was to adapt education to men's lives. The culmination was the Land Grant Act, the purpose of which is 'to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.' So far as agriculture was concerned, the Land Grant Act was somewhat premature. The developing and organizing mechanical and engineering trades were the first to profit by it. Agriculture will now have its turn.

The tide to the limitless west rose and fell, and we came to a pause. The technical problems of the farmer called for solution. His personal difficulties pressed for solution directly on the farm. These problems are of two categories: (1) to remove the special disabilities (insects, fungi, weeds, animal diseases), (2) to augment production (fertilizers, soil studies, tillage, improving plants and animals). Then was born the experiment station (in 1887): the idea is to improve the farm; it is investigational, not educational.

How special the purpose of the experiment station act is, may be seen at once from the purposes that it definitely mentions:

That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories.

The experiment stations are holding to these special fields with great faithfulness. In a lot of three hundred and fourteen bulletins that came to my attention bearing the date of 1903, the following rough classification of subjects was made:

Bulletins, 1903.

Insects, diseases of plants	63 or 20%
Feeding and grazing	52
Fertilizers	37
Farm crops	33
Fruits, orchards	28
Dairy (milk and cheese)	23
Diseases of animals	16
Meteorology	15
Garden vegetables	12
Sugar	7
Natural resources, irrigation	7
Poultry	4
Weeds	4
Ornamental plants	4
Seed germination	3
Educational	3
Forestry	2
General advice, bees exhibitions, plant-breeding, etc	1
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Some epochs are now passing—as the fertilizer epoch based on agricultural chemistry. The larger question of self-sustaining farm management is now pressing. Three categories of technical farm subjects are just now beginning to demand much thought: (1) problems of feeding to increase efficiency of farm animals; (2) problems of breeding of animals and plants for the same purpose; (3) problems of the business organization of the farm, or the development of a farm-plan. We are beginning to apply research to large fundamental questions. The earlier subjects of investigation in the agricultural experiment stations were mostly the smaller and incidental ones. Now the fundamental or backbone crops and products are being investigated in their entirety—the corn crop, the cotton crop, the grass crop, the milk product, the beef product. The experiment stations are originating a kind of constructive investigational method, and the really great questions are ahead of us. Large problems come last.

We are now just coming to the large question of adaptation of special areas to special purposes. In the future one of the problems will be the more perfect adaptation of the kind of farm to soil and climate. As an illustration, the production of domestic animals for meat and for wool has been most extensive on the western border of the developing country for economic reasons, and not because the area is naturally best adapted to this enterprise. The Mississippi valley is primarily adapted to the production of cereals and not nearly as well adapted as the north Atlantic states to the production of grass either as pasture or hay. These Atlantic states are particularly adapted to growing all kinds of trees and of grass. In the course of time, therefore, we may expect that the production of live stock will become more important in the east. Out of this grow some immediate problems. At present, live-stock husbandry in the east can be carried on economically only when large tracts of land can be purchased at low price. It is possible to purchase small tracts of land at comparatively low price, but not possible to purchase large areas. More of the live stock will be raised upon small farms within the more densely populated districts, with comparatively few animals to a place. This will lead to the question of maintaining the improvement in domestic animals. It will mean the gradual substitution of soiling systems for pasturing systems, and this will lead to remoter economic and social changes.

New industries are to be developed. This calls for special governmental recognition. The national Department of Agriculture aids such new enterprises by giving counsel and investigating the special technical difficulties; but is this kind of aid sufficient? If the government helps new manufacturing industries by giving them special privileges, why not aid new agricultural industries by bounties? If a bounty system were to become a recognized public policy (following perhaps the experience with sugar bounties), would it result in undesirable social and economic changes? The money grants to agriculture are only a fair offset to special privileges given to other industries.

THE SOCIAL AND ECONOMIC PROBLEMS.

We are now returning to the farmer, although still holding to the farm. There is a distinct recrudescence of the educational point of view. The new emphasis is to be placed on the man rather than on his crops. The farmer is a citizen as well as a farmer; he is an important factor in public affairs.

The new education must reach the farmer in terms of the whole man—his particular business, his home and its ideals, his relation to good roads, good schools, the church, to social forces, to all that makes up a broad and satisfying country life. We must give attention to the ideals of living, as well as to the ideals of farming. The sanitation of the farm home, the architecture of the buildings (what silent and effective teachers buildings are!), the reading, the character of the farmyard, the questions associated with the bringing up of children, the social and commercial organizations—these are the kinds of subjects that the rising educational impulse must attack.

All this enforces the economic and social questions relating to agriculture. The greatest problems of American agriculture are not the narrower technical ones, but the relations of the industry to economic and social life in general. Agriculture has not as yet been able to call to its aid in any marked degree those forces and tendencies which have culminated and been of such economic value in the general business world, in the great productive and distributive aggregations. The complete solution of the economic ills of American agriculture may not be in cooperation, and yet in both the productive and distributive phases this is perhaps the most apparent remedy. Cooperation in distribution has made a beginning, but cooperation in production is still almost unknown. Are Kropotkin's ideals attainable?

The problem of the supply of capital in agriculture has never been solved in this country other than in the most expensive way. Capital must return to the land. Two factors enter into the problem: (1) to demonstrate that capital can be made remunerative in farmed land, (2) to insure that land will not bear an unjust burden of taxation.

Closely associated with the economic side is the sociological phase. In the days when all were interested in agriculture, both school and church flourished, but in these later days both have lost their molding influence in the country, though the former shows signs of renewed activity vital to the community.

The specific economic and social questions that even now press for study are so numerous that they can not be catalogued in an address of this character. Is there still an active exodus from the country? If so, is the movement caused by purely economic conditions, or is it in part the attractiveness of the city? In other words, does the education of the farmer fit him for the appreciation of the esthetical and philosophical value of his environment? In what relations do the labor-saving devices stand to the rural exodus? Can it in any way be due to super-population of the rural communities? Are the rewards of labor greater in the city than in the country? Is the arrested development of country church and school in any way responsible?

What are the tendencies as to size of farms? Is the American, starting with small individual ownership, tending towards consolidation into larger units? Is the European, starting with large landlorded ownership, tending towards small individual units? Are the small farms decreasing in number? In what way does the development of the railroads and electric roads affect the size of farm properties? In what way do the labor-saving devices influence the size of farms? Could cooperation of farmers remedy any tendency towards large farms? Or, are larger farm units to be desired?

What can cooperation do for the farmer? Must it be economic, social, political, or to increase production? What are the moral and psychological effects of cooperation? What relation can cooperation have to the isolation of the farmer? To his hygienic conditions? Is it possible by means of cooperation to save small individual ownership of farms?

Is it true that the country promotes health better than the city? What are the diseases of the country? Are there mental diseases of isolation? Are most of the farmer's diseases due to his work, environment or poor intellectual preparation to meet the requirements of his condition? What could the state do for the farmer from a hygienic standpoint? What are the relations of farm water supplies to the prevalence of typhoid fever, and other diseases?

How is isolation to be overcome? By a hamlet system? Or by a distributive system of communication—as by better roads, trolley lines, auto-vehicles, rural mail delivery, telephones, traveling libraries, cooperative reading courses? Is the social life of the small village as vital and wholesome as that of the separated farm home?

These are only the merest suggestions of a very few apparent present problems. They are not to be solved by any *a priori* reasoning, nor by using the stock statistics and opinions of economists and sociologists. The field must be newly studied. New data must be collected. New means of attack must be developed. With much painstaking, actual facts in detail must be secured. What is the actual social and economic status of every farmer in a township? a county? a state? Who knows? History must be studied from a new point of view. The very foundation of historical development is public opinion of the common people; and until within the past century the common man was the farmer. Agriculture is the basis of history. The best data of the actual conditions of the people antecedent to the French Revolution are found in Arthur Young's minute description of the agriculture of France. The historian of agriculture is yet unborn.

As an example of the inadequacy of our information on important economic problems, let me cite the most pressing problem just now confronting the American farmer—the question of farm labor. Farm labor is scarce; it is dear; it is inefficient; it is unreliable. Yet we read of the armies of the unemployed, asking for bread. Why? Who can answer? Who has the data? There seems to be not one authority to whom we can turn. It is apparent that these serious pressing problems—scarcity, expensiveness, inefficiency of farm labor—are only symptoms of some deep-seated mal-adjustment.

A large proportion of the labor on farms is done by the farmer himself or his growing family. The inability to find steady employment for laborers is a very difficult problem. Ordinarily, men desire to work all the time and to use their energy to the best advantage. A farmer's family arrives at the productive age when the parent is between forty-five and sixty. The farm does not offer opportunity for the sons because the father still desires to maintain his activity. The farmer does not take the boy into his business to the same extent that other business men do. The result is that the sons must find employment elsewhere, and in the nature of the case can most conveniently find employment on salary. By the time the father is sixty-five to seventy years of age and feels the necessity of giving up the farm, the sons are engaged in other lines of effort which it is not practicable for them to leave. The result is that the farm declines with the declining years of the father and upon his death is sold or becomes a rented farm. Occasionally a parent solves the difficulty; and herein a distinct public responsibility rests on the individual farmer.

Is the farm labor difficulty a too low wage-rate? Is farm labor inefficient merely because it is cheap? If so, how must the farm be made to be able to pay a rate in competition with other labor? Has the tariff contributed to the inequality? Is social poverty of the country districts a cause? Is the lack of continuity, or unsteadiness, of farm labor responsible? Has the decrease in the size of the farmer's family been responsible for part of the trouble? And if so, why has his family decreased? Must the farmer of the future raise his own labor? Must machinery still further come to his aid? If so, what effect will this have on systems of agriculture? Will the urbanization of the country tend to establish a regularity of farm labor? Will cheap railway rates from cities for laborers aid in maintaining the supply of labor for those living on the land, making it possible for them to find work during winter in some neighboring community (it has helped in some parts of Europe)? Can we develop a competent share-working system, in which the owner of the land still retains directive control? And if so, will social stratification result? Must there come a profit-sharing system? Or must the greater number of farmers themselves become employees of men of great executive ability who will amalgamate and syndicate agricultural industries as they have amalgamated other industries? Is the agriculture of the future to be a business of fewer and larger economic units? If so, how will this affect the centers of population and the social fabric? Will the lack of farm labor force us more and more into 'nature farming'—the hay and pasturage systems? What is the farm labor problem?

The country as well as the city must be made attractive and habitable. It must express and satisfy the highest human ideals, else it will not attract the best men and women. In area and in population, the country is the larger part of the national domain; the improving of the ideals of the persons that live therein is one of our greatest public questions. The farmer is the conservative, not the dynamic, element of society. We live in a dynamic social age.

The farmer always will be relatively conservative. His business is rooted in the earth. In a thoroughly well developed agriculture, the farmer does not move his business rapidly from place to place. He remains, while others move on. Therefore, it is especially necessary that we extend to him all the essential benefits of our civilization. (I hope he will not care for the unessential benefits.) He has the rural free delivery of mails—although this was thought to be impossible a few years ago. Shall he not have a parcels post? Each year the good roads movement, originating at the cities, is extending itself farther into the real country. Trolley lines are extending countryward; soon they will come actually to serve the farmer's needs. The telephone, as a separate rural enterprise, is extending itself. Extensional educational enterprises are reaching farther and farther into the open farming districts. Cooperation and organization movements are at the same time extending and concreting themselves.

Farming stands for individualism as distinguished from collectivism. Farming enterprises will be more and more amalgamated and capitalized, but they can never be syndicated and monopolized to the same extent as many other enterprises. How best to preserve and direct this democratic individualism of the open country is one of the greatest questions now confronting us.

The art impulse will soon take hold of the country, as it has already laid hold on the city. We have lived all these centuries on the assumption that work of art is associated with buildings and 'collections.' As nature is the source of all our art, so the time is coming when we shall allow nature herself to express her full beauty and power. We shall go to nature oftener than to art galleries. We shall first remove objectionable features from the landscape—features for which man is responsible—such as all untidiness and blemishes, all advertizing signs, all unharmonious buildings. Then we shall begin to work out our enlarging aspirations with the natural material before us—make pictures with sward and trees and streams and hills, write our ideals in the sweep of the landscape and the color of the flowers. Our 'art' societies still confine themselves to imitation art. The great art societies will be those that give first attention to nature as it is, not merely as it its represented to be in plastic materials and in paints.

Of all the forces that shall revitalize and recrystallize the country, the school is the chief. The schools make the opinions of the nation. The city school has been developed, but the country school has been relatively stationary; yet every farm family is interested in the school. The farmer believes in schooling, just as completely as the city man does; but he may not be convinced that the schools are really touching the problems of life. Persons make more sacrifices for their children than for any other cause. Probably more persons leave the farm to educate their children than for all other causes combined.

An ideal condition would be the total abolition of rural schools as such. The custom of setting apart towns and villages into special school districts in order separately to tax the town or village for school purposes has been a misfortune to the rural schools. The whole school system of any state should be organized on a broad enough basis so that every boy and girl, whatever the occupation of the parents, has the opportunity of securing the same, or at least equally efficient, education. The country mill has gone. The old-time country school is a passing institution. A one-teacher school is as inefficient as a one-man mill. Schools will be consolidated into larger and stronger units. The first pedagogical result will be the differentiation of the work of teachers—perhaps one of these teachers can give special attention to nature-study and country-life subjects.

The school must connect with real life. It will be one of the strong constructive and dynamic influences in our social organization. At present its tendency is receptive and passive, rather than creative. The particular subjects that shall be taught are of less importance than the point of view. Many questions of detail are to be discussed, often with much travail; but the final solution must be to allow every subject in which men engage to find its proper pedagogic place in a wider and freer educational system than the world has yet seen, and to place agricultural subjects with the others and not exclusively in institutions by themselves.

Whatever our doubts and misgivings, the American farmer is bound to be educated. He will demand it. Having education and being endowed with a free chance, he will not be a peasant. Some persons have made the serious mistake of confounding peasantry with comparative poverty. Peasanthood is a social stratum. It is a surviving product of decaying social conditions.

If the open country is to be made attractive to the best minds, it must have an attractive literature. There must be a technical literature of the farm, and also a general artistic literature portraying the life and the ideals of the persons in the country. The farm literature of a generation ago was largely wooden and spiritless, or else untrue to actual rural conditions. The new literature is vital and alive. The new, however, is yet mostly special and technical, with the exception of the growing nature-literature. Artistic literature of the farm and rural affairs is yet scarcely known. Where is the high-class fiction that portrays the farmer as he is, without caricaturing him? Where is the collection of really good farm poems? Who has developed the story interest in the farm? Who has adequately pictured rural institutions? Who has carefully studied the history of the special farm literature that we already have? Who has written the biological evolution progress that attaches to every domestic animal and every cultivated plant? We need short and sharp pictures of the man at his work and the woman in her home—such quick and vivid pictures in words as an artist would throw on his canvas. There is nobility, genuineness and majesty in a man at useful work—much more than there is in a prince or a general or a society leader, whose rôle it is to pose for the multitude. The man holding the plow, digging a ditch, picking fruit, the woman sweeping or making bread—what stronger pictures of human interest can there be than these? If I could have the choice of the mite that I should contribute to the developing and the nationalizing of agricultural sentiment, I should choose its literature.

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ALBATROSS EXPEDITION TO THE EASTERN PACIFIC.*

III.

We left the Galapagos (Wreck Bay) for Manga Reva on the tenth of January. On the northern part of this line we did but little work beyond sounding, as we were likely to duplicate our former work to the eastward. The fourth day out, in latitude 5° south, we began a series of trawl hauls, surface hauls and intermediate towings to 300 fathoms. In the northern part of the line to Manga Reva the hauls were remarkably rich as long as we remained within the influence of the western extension of the Humboldt Current, and as long as there poured from the surface masses of the radiolarians, diatoms and Globigerinæ living in the upper waters. Some of the hauls were remarkable for the number of deep-sea holothurians and siliceous sponges. Among the former I may mention a huge *Psychropotes,* 55 cm. long.

As we passed south and gradually drew out of the influence of the western current we entered the same barren region we passed through to the eastward when going to and from Easter Island. By the time we reached latitude 15° south the hauls became quite poor, and this barren bottom district extended to within a short distance of Manga Reva; and corresponding to it we found a most meager pelagic fauna, both at the surface and down to 300 fathoms—so poor that it could afford but little food to the few species, if any, living on the bottom in that region.

We arrived at Manga Reva on the twenty-seventh of January and found our collier awaiting our arrival.

While at anchor in Port Rikitea we examined Manga Reva, the principal island of the Gambier group, from its central ridge on the pass leading from Rikitea to Kirimiro on the west side of Manga Reva, as well as from the pass leading to Taku. On both these passes we obtained excellent views of the barrier reef to the west, north and east of the Gambier Islands, and we could trace in the panorama before us the western reef extending in a northeasterly direction parallel to the general trend of Manga Reva Island for a distance of about 5½ miles.

From the northern horn to nearly opposite Kirimiro Bay the barrier reef has only three small islets. It is narrow, of uniform width, about one third of a mile, plainly defined, submerged in places, and passing north bounds a large northern bight dotted with numerous interior coral patches from a quarter of a mile to a mile in diameter or length, with from 7 to 11 fathoms. The southern part of the western barrier lagoon off Manga Reva is irregularly dotted with many small patches of reef, with an occasional deep hole of from 15 to 20 fathoms near Manga Reva Island. From the islet to the west of Kirimiro there are but few coral patches, indicating a reef which dips gradually in a distance of a mile to a deep channel of from 4 to 6 fathoms, which separates the northern and western reef from the great reef flat lying to the southwest of Tara Vai. This flat has a width of nearly 2 miles, is about 4½ miles long, and is marked at its southwest extremity by a series of low islets arranged in a somewhat circular line, formed by three deep bays and spurs from the outer line of islets, as so frequently occurs on wide reef flats in atolls of the Pacific.

This part of the reef is called Tokorua. It shelves very gradually from 3½ to 4 fathoms on the west face to 7, and connects with the plateau upon which stands Tara Vai and Aga-kanitai. From Tokorua

* Extract from letter No. 3, from Alexander Agassiz to Hon. George M. Bowers, U. S. Commissioner of Fisheries, on the cruise of the Fisheries Steamer *Albatross*, in the Eastern Pacific, dated Acapulco, Mexico, February 24, 1905.

the reef extends in an indefinite narrow ridge 8 miles long, with from 3 to 8 fathoms, in a southeasterly direction. The western edge is steep to, and the eastern face passes gradually into the lagoon, which at that point has a general depth of 8 to 20 fathoms. The deepest part of this region is at the foot of Mt. Mokoto between it and Tara Vai, though Tara Vai is united with Manga Reva Island by a plateau varying in depth from $3\frac{1}{2}$ to $4\frac{1}{2}$ fathoms.

At the southeastern point of the reef it passes into a wide plateau with from 9 to 10 to 15 fathoms. This plateau is about 9 miles wide southwest of Tekava. That part of the atoll has not been well surveyed, so that the position of the reef flat has not been ascertained further west on that part of the east face; but the southeast passage indicates $5\frac{1}{2}$, 6 and $6\frac{1}{2}$ fathoms, where it probably marks the southwestern extension of the eastern barrier reef, separating the lagoon from the southern plateau to the south of the encircling reef.

The western face of Manga Reva and of Tara Vai are indented by deep bays, which are formed by spurs running from the central ridge of these islands, the remnants probably of small craters which flanked the large crater, of which Manga Reva forms the western rim and Au Kena is the remnant of the southeastern edge, the former extension of this rim being indicated by the spits uniting the base of Mt. Duff with Au Kena; and by the projection of Au Kena towards the outer barrier reef, and of the numerous patches of coral reef off the northeast point of Manga Reva towards the outer line of motus until they almost unite with the barrier reef.

The whole of the western bays of Manga Reva Island is filled with fringing reefs which leave but here and there a deeper pass to the shore. The south face at the foot of the bluff of Mt. Mokoto and Mt. Duff is edged by a flourishing fringing reef, which extends nearly half a mile on the plateau at their base. The port of Rikitea is a reef harbor formed within the large fringing reef which occupies the whole of the southern bay of Manga Reva Island. The east face of Tara Vai and part of the east and of the west face of Aga-kanitai are also fringed with reefs.

The islets and the islands of Aka Maru, Makiro and Makapu are within a fringing reef flat which runs around the west face of Aka Maru; Au Kena is also fringed by an extensive reef which runs out in a spit of more than half a mile in a northeasterly direction almost to the outer line of motus, which are nearly united with it by these irregular patches. To the west of Au Kena a huge spit of 2 miles in length extends towards the base of Mt. Duff and almost unites with the fringing reef off the Cemetery, leaving a narrow but deep pass for the entrance of ships into the inner harbor of Rikitea. There is only 1 to $2\frac{3}{4}$ fathoms of water on these two spits.

The depth of the basin within this area with from 25 to 31 fathoms would be naturally explained as being part of an ancient crater, as in Totoya in Fiji; its northeastern rim is also, perhaps, further indicated by the comparatively shallow flat of the lagoon to the west of the barrier reef, with from 5 to 11 fathoms of water.

The principal islands of the group are in the central part of the lagoon. The four larger islands are Manga Reva, Tara Vai, Au Kena and Aka Maru. Tara Vai is flanked by Aga-kanitai and another islet to the west called Topunui; Aka Maru is flanked by Mekiro to the north and by Maka-pu to the south. The southeast face of Aka Maru is an extinct crater, of which Maka-pu forms the south rim. The main ridge of Tara Vai is the edge of parts of three craters now opening to the west. The four small volcanic islands in the southern part of the lagoon are isolated fragments, steep, greatly weathered and disintegrated. No soundings exist to show their relation to the other islands of the group.

The soundings thus far made indicate in the southern part of the lagoon a depth of about 23 fathoms, with an occasional hole of from 38 to 40, and a gradual slope towards the outer sunken reef. To the south of the old crater of Manga Reva the general depth of the bank varies from 6 to 11 fathoms, with a deeper channel varying from 20 to 40 from southwest of Au Kena towards Tara Vai. The lagoon seems to form a western basin where the depth varies from 10 to 20 fathoms. To the west of Au Kena and Aka Maru, lying between them to the line of the outer barrier reef islets, a similar but shallower and flat basin exists, off the northern end of Manga Reva, between it and the northern horn of the barrier reef, with from 7 to 11 fathoms. Its rim is formed by a ring of reef patches of varying size.

On two occasions we visited the outer barrier reef and examined the outer line of islets of the eastern face of the Gambier Islands. The position of the islets as marked on the chart is not that of to-day, and the position of the reef flats is not accurate. The position of Tekava and Tauna appears to be correct. Opposite Au Kena and in its extension, the east face of the barrier reefs projects sharply to the east, forming an angular horn with one island south of the horn and the other north, running at sharp angles with it, so as to form a triangle which makes a deep bight opening westward to such an extent that when off the northern side of the horn we could see Tekava far to the westward of it. The second island is followed by a third and then by an island (Taraururoa) nearly 2 miles long; these are separated by small gaps. Then comes a larger island (Amou) followed by three small islands separated by deep gaps.

At Vaiatekeue (not the Vaiatekeua on the chart) the reef flat becomes quite narrow; it is hardly more than 100 yards wide; the islets perhaps 50. The northern islets are small and separated by long stretches of low shingle and carry but little vegetation and very few cocoanut trees. There are but two short sand beaches all the way from the northeastern to the eastern horn of the eastern face of the encircling reef of Manga Reva. A regular dam of shingle from 10 to 14 feet high, on the top of which the usual coral reef vegetation flourishes, extends along the inner face of the reef flat, which varies from 50 to 150 yards in width, and is flanked at the base by low buttresses of modern elevated coral reef rock and of breccia, in places all more or less weather beaten and honeycombed.

The islets and their formation and their junction or division into larger or smaller islets and the gaps which separate them; the mode of formation of the buttresses, of the planed-off, hard, nearly level reef flat, of the coralline mounds of the outer edge—all these differ in no way from what has been described in other barrier reef islands and atolls of the Pacific.

The beaches of the lagoon are steep, and corals do not seem to thrive in those parts of the lagoon to which the sea does not have access or at some distance from shore. This is well shown by the vigorous growth of corals in the fringing reef to the south of Mt. Duff on the outer edges of the reef patches of Port Rikitea, and on the spits which connect Au Kena with Manga Reva, in contrast with those along the west face of the lagoon flats to the west of the eastern barrier reef.

There is a northeast horn of the eastern barrier reef in the extension of Manga Reva Island, forming the northern culmination of the central bight of the eastern face of the barrier reef. From that point the reef flat runs westerly to form the northern horn about 3 miles north of Manga Reva Island. The position of the outer reef can not be correct on the chart (H. O. No. 2024). On leaving Manga Reva we made three soundings close off the reef flat line of breakers—one off Tekava, at the most one third of a mile from the reef, in 225 fathoms. Our position, plotted by tangents to the volcanic islands or by their summits, indicated in this case, on the chart, a distance of 1½ miles. A second sounding of 245 fathoms off the eastern horn at less than one half mile indicated on chart No. 2024 a distance of 2 miles from the horn; and a sounding of 241 fathoms one fourth of a mile off the point which we had visited (Vaiatekeue) indicated a distance of three fourths of a mile on the chart.

The slope of the Gambier Archipelago to the east is steep. On coming in sight of Manga Reva we sounded in 2,070 fathoms at a distance of 11 miles from Mt. Duff, that is, 6 miles from the outer edge of the reef bearing southwest; and on coming out we sounded again half-way to that point at a distance of 3¼ miles from the breakers in 1,394 fathoms.

One can not fail to be struck with the similarity of the Manga Reva Archipelago with the great atoll of Truk. If I remember rightly, Darwin also called attention to this from a study of the charts. Yet, owing to the great size of Truk, no less than 125 miles in circumference, and the great distance of the barrier reef from the encircled volcanic islands, the effect as one steams into Manga Reva is totally different from that produced by Truk. In the latter some of the islands, though large, and of the same height as those of Manga Reva, are much more scattered, and seem of comparatively small importance in the midst of the huge lagoon which surrounds them. The barrier reef islets of Truk are from 11 to 15 miles distant from the encircled volcanic islands. In Manga Reva, which is only 45 miles in circumference, after passing the small islands in the southern and open part of the lagoon when once off Maka-pu, we can fairly well take in the atoll as a whole. The western island (Tara Vai) is only 5 miles off; Manga Reva and Au Kena are about 3, as are also the islets of the east face of the barrier reef; these distances, as you approach the entrance to Rikitea, are constantly growing less, so that when in the gap between Manga Reva Island and Au Kena, at the foot of Mt. Duff, none of the larger islands is more than 3 miles off; and the islets of the eastern face of the barrier reef are seen to the northeast about 4 miles off. When on the summit of the central ridge of Manga Reva one can, in a radius of a little more than 4 miles, take in the whole panorama of Manga Reva, and get an impression of the relations of its different parts far better than can be conveyed by the chart, for the whole of the visible part of the archipelago is included in a line drawn east and west, south of Maka-pu; south of that line the position of the southwestern reef can be traced only by the discoloration of the waters.

Manga Reva is an intermediate stage of erosion and denudation, between a lagoon archipelago such as Truk and a barrier reef island like Vanikoro, and other islands in the Society groups such as Bora Bora,* Huaheine, Raiatea, Eimeo, in which the surrounding platform has comparatively little width and the barrier reef is close to the principal island and often becomes part of its fringing reef. Manga Reva is open to the south and to the west, Vanikoro to the east, while the volcanic islands of Truk

* See A. Agassiz, 'The Coral Reefs of the Tropical Pacific,' plates 210 and 231.

are completely surrounded by the outer encircling barrier reef, as are the Society Islands just mentioned, which have several wide passages into the lagoon through the wide barrier reef.

One is tempted to reconstruct the Gambier archipelago of former times, and to imagine it with a great central volcano, of which Manga Reva and Au Kena are parts of the rim which once were connected from the southeast point of Manga Reva to Au Kena, and thence along the line of the outer islets to the northeast end of the former island with a deep crater of more than 34 fathoms. On the west face it was flanked by smaller craters extending to the western islets of the barrier reef, of which the bays of Taku, Kirimiro and Rumaru, and the bays of the west side of Tara Vai are the eastern ridges. There were probably also other secondary volcanoes, of which Aka Maru and the islets of the south part of the lagoon are the remnants, the latter all being situated on the gentle slope of the southern part of the Manga Reva plateau; this may have been the southern slope of the principal volcano of the group, on the face of which have grown up the outer lines of the barrier reef and its islets.

The existence of a great central volcano would readily explain the great depth of the lagoon in its different regions, as well as the great depth off the outer face of Manga Reva, depths showing slopes which are no steeper nor more striking than the height and slopes of the southern part of Manga Reva or Tara Vai, of Aka Maru and of Maka-pu, supposing them to be extended into the sea.

Mt. Mokoto and Mt. Duff drop precipitously for more than one third their height and in less than a quarter of a mile fall from over 1,300 feet to the level of the sea. Similar slopes are found along the volcanoes of Easter Island where there are no coral reefs. The edge of the crater of Rana Kao drops perpendicularly a height of nearly 1,000 feet in less than one eighth of a mile horizontal distance; and the eastern face of the crater of Rana Roraka rises vertically about 800 feet above the plain of Tangariki.

It is interesting to note how poor is the flora of the Manga Reva archipelago as compared with that of the more western volcanic islands like the Marquesas and the Society Islands and some of the western elevated Paumotus. In the Gambier Archipelago the forests are reduced to a few patches extending along the small valleys of the slopes of the volcanic spurs. I am informed that even in the thirties of the last century, when the missionaries first landed at Manga Reva, the forest trees, while more numerous, yet never attained the luxuriance of growth that they attain in the Society and Marquesas Islands. At the present day, with the exception of the forest patches just mentioned and a few trees which have been introduced for cultivation, the islands of the group are in great part thickly covered with a species of cane closely resembling that of our southern states. The fauna of Manga Reva is also extremely poor. There are no mammals, and with the exception of a 'sandpiper' no indigenous birds. Sea birds are few in number, and in our trip in the eastern Pacific we rarely had more than three or four birds accompanying us; often only one, and frequently none was visible for days. There are a few lizards on the islands, apparently of the same species as those in the Society Islands.

We left Port Rikitea for Acapulco on the fourth of February to anchor off Aka Maru; on the fifth we left our anchorage, sounded off the east face of Manga Reva, and took photographs.

On our way north from Manga Reva to Acapulco we did not begin to trawl or tow until warned by the surface nets that the surface was becoming richer in animal and vegetable life and also by the surface temperatures indicating that we had reached the southern edge of the cold western equatorial current. A little north of 10° south latitude we made our first haul and deep tow, and found a very rich fauna down to the 300-fathom line, recalling the pelagic fauna of the eastern lines and fully as rich. On trawling we found, as we expected, a very rich bottom fauna.

Among the animals brought up in the trawl there were some superb *Hyalonema*, siliceous sponges, *Benthodytes* and other deep-sea holothurians, fine specimens of *Freyella*, and some large ophiurans. This haul is interesting as showing that in the track of a great current, with abundance of food, we may find at a very considerable depth (2,422 fathoms) an abundant fauna at very great distances from continental lands. We were, at this station, about 2,140 miles from Acapulco, 1,200 miles from Manga Reva, 1,700 miles from the Galapagos and about 900 miles from the Marquesas.

Another haul made under the equator near the northern edge of the cold current in 2,320 fathoms gave us the same results. The pelagic fauna was very abundant, the surface teemed with radiolarians, diatoms and Globigerinæ, and swarmed with invertebrates. The trawl contained a superb collection of bottom species of holothurians, *Brisinga, Hyalonema, Neusina,* and on this occasion we brought up the only stalked crinoid collected during this expedition—parts of the stem of two specimens of *Rhizocrinus*, of which, unfortunately, the arms were wanting.

Our progress, which was excellent during the first days of our journey after leaving Manga Reva, has for the past six days been greatly impeded by head winds in the region where we ought to have been in the full swing of the southeasterly trades. This led us, with great reluctance, to abandon all idea of further work in the equatorial belt of currents; to give up our proposed visit to Clipperton, and on account of our limited coal supply, to make for Acapulco, merely sounding every morning. This was a great disappointment to me, as we had every reason to expect to be able to spend some time in the region of the equatorial current belts and settle more conclusively than we have been able to do the question of their influence upon the richness of the fauna living in their track far from continental shores or insular areas.

The presence of diatoms in all parts of the Humboldt Current, which we crossed from south of Callao to the equator at the Galapagos and west towards Clipperton, shows how far the track of a great oceanic current can be traced, not only by its temperature but also by the pelagic life within or near it. When once in the warm westerly equatorial current the diatoms disappear and the bottom samples show only surface radiolarians and Globigerinæ.

We took a number of serial temperatures in the line Galapagos-Manga Reva, passing from the colder water of the Humboldt Current to the warmer waters south toward Manga Reva. The temperatures at 200 fathoms became nearly identical. North the great change in temperature took place between 25 and 200 fathoms, where there was a difference of 24°. South the warm water extended 100 fathoms, a great change occurring between 100 and 200 fathoms, a drop of 16°. The serial temperatures taken at the southern and northern edges of the cold current on the line Manga Reva-Acapulco agreed well with those taken in the same current to the east.

The samples of the bottom obtained by the soundings taken by the expedition or gathered in the mud-bag and in the trawl indicate that an immense area of the bottom of the eastern Pacific is covered with manganese nodules, and that they play an important part in the character of the bottom, not only in the area covered by this expedition; the area of manganese nodules probably extends to the northwest of our lines to join the stations where manganese nodules were found by the *Albatross* in 1899 in the Moser Basin, on the line San Francisco-Marquesas. This area may also extend south of our lines Callao-Easter Island, and join the line west of Valparaiso, where the *Challenger* obtained manganese nodules at many stations. I do not mean to imply that the manganese nodules are present to the exclusion of radiolarians and of Globigerinæ. It is probable that the layer of nodules is partly covered by them, and by the thick, sticky, dark chocolate-colored mud which is found wherever manganese nodules occur.

During this expedition we sounded every day while at sea and developed very fairly that part of the eastern Pacific which lies to the south and west of the line from Cape San Francisco to the Galapagos and west of a line from Galapagos to Acapulco, limiting an area occupied by the *Albatross* in 1891. The area developed by us is included by a line 3,200 miles in length from Acapulco to Manga Reva and the area north of a line from Manga Reva to Easter Island and from Easter Island to Callao. We developed on our line Galapagos to Manga Reva the western extension of the Albatross Plateau, and found it of a depth varying from 1,900 to somewhat less than 2,300 fathoms in a distance of nearly 3,000 miles; but about half-way from the Galapagos to Manga Reva we came upon a ridge of about 200 miles in length with a depth of 1,700 to 1,055 fathoms, dropping rapidly to the south to over 1,900 fathoms. I propose to call this elevation Garrett Ridge.

Our line from Manga Reva to Acapulco continued to show the western extension of the almost level bottom of the eastern Pacific. In a distance of 3,200 miles the depth varied only about 400 fathoms. This great area was practically a *mare incognitum*. Three soundings in latitude 20° south towards the Paumotus and five soundings in a northwesterly trend from Callao to Grey Deep are all the depths that were known previously of this great expanse of water. This existence of the great plateau dividing Barber Basin along the South American coast from Grey and Moser Basins to the west is most interesting. It recalls the division of the southern Atlantic into an eastern and western basin by a central connecting ridge. The Albatross Plateau joins the western extension of the Galapagos Plateau as developed by the *Albatross* in 1891.

The existence of a sounding of 2,554 fathoms near the equator in longitude 110° west would seem to indicate a small basin included in this plateau disconnected from Grey Deep and Moser Basin by its extension to the west. How far west towards these basins that extension reaches no soundings indicate as yet. It is interesting to note that along the Mexican coast there are a number of deep basins lying disconnected close to the shore just as we found a number of disconnected deeps close along the South American coast extending from off Callao to off Caldera, Chili, opposite high volcanoes or elevated chains of mountains. These basins and a great part of the steep Mexican continental shelf are deeper than the Albatross Plateau to the south and form a deep channel separating in places the plateau from the steep continental slope. The steepness of the continental shelf is well seen, especially off Acapulco and Manzanilla. One of the small basins along the Mexican coast, with 2,661 fathoms, lies off Sebastian Viscaino Bay; another, with more than 2,900 fathoms, is to the west of Manzanilla Bay; a third, to the southeast of Acapulco, has about the same depth, and a fourth, with 2,500 fathoms, is off San Jose, Guatemala. Our last sounding off Acapulco about 29 miles south of the lighthouse, in 2,494 fathoms, showed the western extension of one of these deep holes to the east of Acapulco. These basins off the west coast, close to the shore at the foot of a steep continental slope, are in great contrast to the wide continental shelves which characterize the east coast of Central America and the east coast of the United States.

The collections made during the present expedition will give ample material for extensive monographs on the holothurians, the siliceous sponges, the cephalopods, the jelly-fishes, the pelagic crustaceans, worms and fishes of the eastern Pacific, as well as on the bottom deposits and on the radiolarians and dinoflagellates, diatoms, and other protozoans collected by the tow nets. Small collections of plants were made at Easter Island and Manga Reva which may throw some light on the origin and distribution of the flora of the eastern Pacific.

SCIENTIFIC BOOKS.

Radioactivity. By E. Rutherford, D.Sc., F.R.S., R.R.S.C., MacDonald Professor of Physics, McGill University, Montreal; Cambridge Physical Series. Cambridge, University Press, 1904.

Within recent years books dealing specifically with radioactivity or the cathode rays have naturally not been infrequent. Beginning with the pioneering treatise of Stark ('Elektricität in Gasen,' 1902), Madam Curie's account of radioactive substances, Villard's 'rayons cathodiques,' G. C. Schmidt's 'Kathodenstrahlen' (1904), Besson and D'Arsonval's 'Le radium' (1904), Blondlot's 'rayons N' (1904) and others, have followed in quick succession. But Mr. Rutherford's book is on quite a different scale from most of these, and written in a way that betrays consummate mastery of the subject. One would have been grateful if he had given us merely a systematic account of his own researches. The book before us does much more than this, presenting a readable and most painstaking digest of the subject as a whole, or at least of that splendid part of it which owes its development chiefly to English genius.

In the introductory part separate chapters are devoted to radioactive substances, to the theory of ionization, and to methods of measurement. Then comes a long account of the nature of the radiations. The sharply articulated descriptions which follow, and the suggestions lavishly offered for the completion of most of them, are a feature of the book here and in succeeding chapters. The short account of the rate of emission of energy is absorbingly interesting, and would be startling if our expectation were not blunted by the expressions of astonishment so much in vogue in connection with this subject. In the chapter on radioactive matter, Mr. Rutherford develops the important principle that the activity of a product at any time is proportional to the number of atoms which remain unchanged at that time, a subject to which he has himself so prolifically contributed. This is supplemented by a long chapter on radioactive emanations, giving a succinct account of the work for which the Rumford medal of the Royal Society was recently awarded.

The interesting phenomenon of excited radioactivity, of which Rutherford shares the honor of discovery with the Curies, is next discussed in detail and leads naturally to the final résumé on radioactive processes, in which the full theory of atomic disintegration is developed. The consequences of this theory have been brilliantly substantiated, even in the more recent papers which Rutherford contributed to the congress at St. Louis and elsewhere. At the end of the chapter is a summary of the present state of our knowledge of the age of the sun and of the earth. The book closes with an account of the radioactivity of ordinary materials.

We have noticed but few misprints: p. 55, m for u; p. 265, t for n; p. 336, omission of dt. We should have been grateful, however, for a more generous use of italics. Mr. Rutherford is apt to express himself with no uncertain sound against the interminable drawl of less gifted investigators. Nevertheless, the subject of radioactivity, which is now in the glare of the footlights, may not be there indefinitely, and a more liberal variegation of the text for the benefit of the lazy reader, may not in any case be an unreasonable condescension.

To have produced a fresh book, broad in scope and accurate in its statements, on a subject which has now for years been the chief topic of animated discussion in the physical and other magazines, is Mr. Rutherford's great merit in this work, quite apart from its character as a summary of original investigation.

Carl Barus.

Brown University,
Providence, R. I.

Die Ernahrung der landwirtschaftlichen Nutztiere. Von Dr. O. Kellner, Geh. Hofrat und Professor, Vorstand der Kgl. landw. Versuchstation Möckern. Berlin, Paul Parey. 1905. 8vo. Pp. viii + 594. Cloth. Price 13 Marks.

Notwithstanding the vast amount of investigation upon stock-feeding problems which has been carried on during the last forty years in the experiment stations of Germany and later of the United States. as well as to a certain extent elsewhere, it is unfortunately true that the theoretical basis of the subject has shown relatively little advancement since Henneberg's earlier researches in the sixties. We still, as then, reckon largely with the so-called 'digestible nutrients' (protein, carbohydrates and fat) and still assume that their amount measures, at least approximately, the nutritive value of feeding stuffs. True, we have had an uneasy consciousness for some time that this was far from being strictly correct, but in the absence of any better method of comparison we have rather blinked the fact and each writer has followed in the footsteps of his predecessor with, perhaps, the addition, of late years, of some more or less critical statements regarding energy values.

Dr. Kellner's book marks a new departure in the literature of the subject. Its well-known author was the first to suggest, in the year 1880, in connection with investigations upon the nutrition of working horses, that the values of different feeding stuffs might be compared upon the basis of their content of potential energy. Within a comparatively few years thereafter the study of the food as a source of energy to the animal organism was systematically taken up by Rubner and the foundations of the subject were laid. Since then a large amount of investigation upon the nutrition of carnivorous animals and of man has been executed in which Rubner's work has furnished the guiding idea. As regards the nutrition of domestic herbivorous animals, however, scarcely any investigations had been made from this standpoint when, in 1893, Dr. Kellner was called to the directorship of the Möckern Experiment Station. There he at once took up the subject, his first results and an outline of his methods being published in 1896. Since that time the work has been carried forward vigorously under his direction and most important results have been secured.

The present book embodies the results of Kellner's investigations, including many that have as yet been published only in abstract, but covers a much broader field than a mere compendium of this work and is an attempt to treat the subject of stock feeding systematically from the new standpoint. The book is divided into three parts. Part I. treats of the composition, digestibility and utilization of feeding stuffs, containing chapters upon the constituents of feeding stuffs, the digestibility of the feed, the utilization of the digested materials in the animal body, the metabolism of matter and energy under various conditions and the influence of muscular work on metabolism. Part II. treats of feeding stuffs, covering such subjects as methods of harvesting and preserving, the preparation of feeding stuffs and a somewhat detailed description of the different feeds. Part III. treats of the feeding of farm animals under the conditions of agricultural practise, including maintenance feeding, the fattening of mature animals, the feeding of working animals, the feeding of growing animals and the feeding of milking animals.

Part I., and especially the chapters upon metabolism, will be of much interest to the student of nutrition in general, but the special value of the book is found in Part III., in which is made the first serious attempt to apply the more recent knowledge regarding the energy relations of feeding stuffs to practical use. It abandons definitely the assumption which has underlain nearly all previous works of this character that the digestible nutrients, so-called, of a feeding stuff are a measure of its value. In place of this, Kellner puts the actual productive value as worked out by his own investigations and which is shown to differ very widely in many cases from the indications given by the digestible nutrients. While he does not fail to point out that the basis for an undertaking of this sort is still somewhat narrow, yet he believes that the time is ripe for a beginning. He has accordingly, in the appendix, given a series of tables in which the productive value of feeding stuffs is estimated, largely upon the basis of his own results, while the so-called feeding standards are also expressed upon the same basis.

While it is, perhaps, to be regretted that the author has expressed his feeding values in the form of starch equivalents instead of boldly adopting the terminology of energy, and while it can not be denied that his tables are based to a considerable degree upon estimates, nevertheless the book promises to mark a distinct stage of development in the theory of stock feeding and will be welcomed by the large number of those who have become dissatisfied with the present conventional methods in this subject.

H. P. Armsby.

SCIENTIFIC JOURNALS AND ARTICLES.

The contents of the *American Journal of Mathematics* are as follows:

Alexander Chessin: 'On a Class of Differential Equations.'

L. P. Eisenhart: 'Surfaces with the Same Spherical Representation of their Lines of Curvature as Pseudospherical Surfaces.'

Virgil Snyder: 'On the Forms of Sextic Scrolls having no Rectilinear Directrix.'

Leonard Eugene Dickson: 'Determination of the Ternary Modular Groups.'

The April issue of the *Journal of Nervous and Mental Disease* opens with a paper by Dr. William P. Spratling and Dr. Roswell Park, on 'Bilateral Sympathectomy for the Relief of Epilepsy,' with report of three cases, and notes on the physiologic effects of cutting the sympathetic, and on the histologic changes found in the cases in question. The microscopical findings are illustrated by two plates. Dr. F. W. Langdon follows with a paper on myelomalacia, with especial reference to diagnosis and treatment, illustrated by charts, and Dr. Arthur Conklin Brush discusses the medico-legal aspects of traumatic epilepsy. The Society Proceedings reported this month include the meeting of the Boston Society of Psychiatry and Neurology held November 17, 1904, and that of the Chicago Neurological Society of the same date.

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 166th meeting was held on March 22. The regular program included:

The Coal Measures of Brazil: Dr. I. C. White.

Dr. White discussed the character and distribution of the coal-bearing beds of southern Brazil. The series consists of coarse conglomerates, and gray sandstones at the base, alternating with blue and gray shales up to 350 to 400 feet above the granite upon which the measures rest in the states of Santa Catharina and Rio Grande do Sul, where his principal studies were prosecuted during the past year. Above these basal sandstones, the coal beds occur three to four in number through a thickness of 200–250 feet of alternating gray sandstones, clays and shales. There are two principal coals, the 'Bonita' bed at the base, and the 'Barro Branco' near the top of the coal series. The coal is high in both ash and sulphur, but can be used successfully for locomotives, stationary boilers, etc., in a region where imported coal costs not less than $10 per ton at the seacoast.

Above the coal-bearing member succeeds a series of sparingly reddish clays, and gray sandy shales and sandstones which are followed by light blue shales up to a horizon of dark limy shales which in the states of Paraná and São Paulo contain numerous reptilian remains, *Stereosternum tumidum* of Cope having been found at this horizon, as well as many fossil stems of trees, etc.

Dr. White found at this horizon in Paraná what Osborn pronounces a new form, specifically and possibly generically different from Cope's. It resembles *Mesosaurus tenuidens* of Gervais from the Karoo beds of South Africa.

Above the black shales, *red beds* of alternating shale and sandstone become conspicuous, while capping the same is a great massive conglomerate sandstone often baked and vitrified by the immense outflows of diabase, and basaltic eruptives which penetrate the series at all angles, and which piled in enormous masses on top of the sedimentaries make up the Serra Geral. The entire sedimentary series has a thickness of 2,250–2,500 feet.

Two prolific horizons for fossil plants were discovered by Dr. White, one only 200 feet above the base of the series, and the other 150 feet higher. In these was discovered the genus *Glossopteris* and other forms, some of which are new to science, and which have been entrusted for study and description to Mr. David White. The evidence from the fossil plants and animal remains appears to place these rocks in the Permian, and to correlate the formation with the Karoo beds of South Africa, and the Gondwana series of India.

The Dwyka and Talchir conglomerates of those countries appear to have a corresponding representative in the coarse conglomerates which rest upon the granite in Santa Catharina and Rio Grande do Sul, fifty to sixty miles inland, from the Atlantic coast.

Dr. White will return to Brazil during the present summer to finish up his studies of this coal series for the Brazilian government.

Flora of the Brazilian Coal Measures: Mr. David White.

The paleobotanical material collected by Dr. I. C. White was discussed with special reference to its relation to the *Glossopteris* province. The greater part of the material is from two horizons and localities. The first, near Minas, Santa Catharina province, in a bed below the productive coals and only about 200 feet above the old crystallines, reveals *Glossopteris indica, Gangamopteris obovata, G. cyclopteroides, Phyllotheca* cf. *australis* and *Noeggerathiopsis Hislopi,* besides several new generic and specific types. The second important collection, from the roof of the Irapua coal, in the province of Rio Grande do Sul, at a horizon determined by Dr. White as about 150 feet higher, it being among the productive coals, contains *Glossopteris indica, Noeggerathiopsis Hislopi, Ottokaria* sp. and *Cardiocarpon* sp. The occurrence of *Lepidodendron Pedroanum, Lepidophloios laricinus* and the lepidophytic spores, previously reported from Brazil and especially interesting as showing the contact of the Glossopteris, or Paleoantarctican, flora with the northern Carboniferous flora, becomes all the more interesting and important in view of their local stratigraphic position which was found by Dr. White to be still a little higher than that of the plants last named. The inclusion of southern Brazil in the Indo-Australo-South African or 'Glossopteris' province is, therefore, fully confirmed by the evidence thus brought to hand. The *Glossopteris,* found abundant though fragmentary at Irapua, represents the form described by Seward from South Africa, where it is similarly associated with representatives of the northern lepidophytes. The new material tends to corroborate the conclusion reached by M. Zeiller, that the Brazilian coals are probably of Permian or possibly latest Coal Measures age, their place being apparently in the Karharbari-Newcastle stage.

Mr. W. T. Schaller described the 'Tourmaline Mines of California.'

Geo. Otis Smith,
Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

The 158th regular meeting of the society was held Thursday evening, April 13, in the

Assembly Hall of the Cosmos Club. The following program was presented:

The first paper for the evening was delivered by Dr. N. Monroe Hopkins, upon 'The Construction and Operation of Small Electric Furnaces.' The necessary apparatus and appliances were exhibited and a description of the construction and operation of several furnaces was given.

Dr. Chas. W. Waidner, of the National Bureau of Standards, delivered an address upon 'Available Methods of Measuring Temperature.' Numerous stereopticon illustrations were shown and specimens of various forms of thermometers, pyrometers, etc., were described and exhibited.

An adjourned meeting of the Chemical Society of Washington was held Saturday evening, April 15, 1905, in the chemical lecture hall of the Johns Hopkins University, Baltimore, Md.

After a short address of welcome to the Washington members by President Remsen, the following program was presented:

The first paper, entitled 'A New Combustion Furnace,' was presented by Dr. H. N. Morse. A complete furnace connected up ready for operation was shown on the lecture table and a full description of the construction, uses and advantages of the new furnace was given.

The second paper, entitled 'New Appliances in the Works Laboratory,' was presented by Dr. Edward Kellar. A stirring and also filtering apparatus, providing for the manipulation of a series of solutions at a single operation was illustrated and described. A number of improved tongs, etc., for use in handling sets of scorifiers, lead buttons, cupels, etc., at one time in fire assays, were shown and their use described.

A paper entitled 'New Evidence Bearing upon the Existence of Hydrates in Solution' was presented by Dr. H. C. Jones.

The last communication of the evening was presented by Dr. G. W. Lehmann, who gave a description of the investigations which the health department of Baltimore has recently instituted to determine if possible whether the high infantile mortality in certain sections of Baltimore could be connected with the milk supply of those sections of the city. The results of the investigation indicated that the trouble was probably due to inferior brands of condensed milk which are consumed in large quantities by the residents of south Baltimore.

A. Seidell,
Secretary.

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

The fifty-ninth regular meeting of the section was held on Friday evening, March 31, at the 'Tech Union,' Massachusetts Institute of Technology, with President Norris in the chair. About 100 members were present.

Mr. George W. Rolfe was elected a member of the executive committee to fill the vacancy caused by the death of Dr. C. O. Weber.

A eulogy of the late Mr. Frederick J. Warren was read by Mr. Robert S. Weston.

The meeting was devoted to a discussion of the subject, 'Expert Chemical Evidence.' Mr. Arthur D. Little opened the subject with a historical introduction, and treated the subject from the side of an expert in patent causes. Professor E. J. Bartlett described the procedure and position of an expert witness in criminal cases. Professor Henry Carmichael discussed some of the evils of present court procedure in relation to the positions, and the qualifications necessary for a successful expert. Dr. B. F. Davenport gave a reminiscent account of varied experiences as an expert witness. Professor L. P. Kinnicutt discussed the position of the expert in relation to his clients and the court. Mr. A. E. Leach described the position of the state expert in cases of prosecution for infractions of the pure food laws. Professor S. P. Sharples discussed the position of the expert towards the lawyer, who is conducting the case for his client.

Arthur M. Comey,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The seventh meeting of the club for the year 1904–5 was held on Tuesday, April 18, at 7:30 P.M., in the physical lecture room, Science Hall. The program of the evening consisted of an address by Dr. L. Kahlenberg, on the subject, 'The Nature of the Process of Osmosis.' The speaker presented the main results of an extensive experimental study of osmotic phenomena in which so-called semipermeable membranes have largely figured. Much of the work was done with non-aqueous solutions of various kinds. The speaker held that the substance which passes through the membrane dissolves in the latter, and is extracted from the resulting quasi-solid solution by the liquid bathing the other side of the membrane. He showed that whether osmosis will take place or not depends upon the nature of the membrane and the liquids in contact with it. On the basis of the views set forth, he could furthermore predict in which direction osmosis would take place and specify which substances would pass through the membranes.

The quantitative measurements of osmotic pressures were made with a new and unique form of apparatus, the results obtained with semipermeable membranes showing that the osmotic pressure does not follow the gas laws. The views of osmosis set forth are much like those of Overton who worked along physiological lines. It is of special interest to note that the speaker found cases where colloids pass through membranes much more rapidly than crystalloids, thus furnishing instances in which the commonly accepted views which we owe to Graham are completely reversed. The results of this investigation will be published in detail by the speaker in the near future.

F. W. Woll,
Secretary.

THE TORREY BOTANICAL CLUB.

At the meeting of the club held on March 29, 1905, at the New York Botanical Garden, Vice-President Underwood in the chair and twenty-three additional members present, the following papers were read:

'Remarks on Californian Conifers,' by Le Roy Abrams. The conifers of California have been of extreme interest to the botanical world from the time that that country was first explored. Nowhere do we find such unique trees as the sequoias, and nowhere is there such a profusion of genera and species. Nearly two thirds of the species of the United States, and all but two of the genera occur within the state. The distribution of these species, especially of some of the more local ones, is of considerable interest, and it was upon this subject that Mr. Abrams chiefly dwelt.

By far the greater number of species occur in the extreme northern part of the state. Here, within a radius scarcely exceeding one hundred miles, no less than eleven genera and at least thirty species may be met with. This great profusion is mainly due to the fact that we have in this region a mingling of the typical Californian species with those of the northwest.

Nearly all of the local species are confined to the coastal region. Some of these, such as *Pinus Torreyana, Abies venusta* and *Cupressus macrocarpa,* are extremely local, indeed. The causes of this peculiar distribution along the coast are of great interest and suggest a field for investigation which is full of untold possibilities. Mr. Abrams was of the opinion that present climatic conditions together with the broken and unconnected mountains were no doubt largely responsible for the present status of distribution. He suggested that the great changes in land areas to which this region has been subjected during very recent geological time must have had much to do with shaping the destiny of the flora.

After considerable discussion adjournment followed.

Edward W. Berry,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA.

The 160th meeting of the Elisha Mitchell Scientific Society was held in the Chemical Lecture Room, Tuesday, 7:30 P.M., April 11, 1905. The following papers were given:

Professor J. E. Latta: 'The Edison Storage Cell.'

Professor H. V. Wilson: 'The Organization of the Ovum.'

Professor Collier Cobb: 'Autophytographs.'

A. S. Wheeler,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

A PLEA FOR INCREASED REVIEWING OF SCIENTIFIC LITERATURE.

It has seemed to the writer that more attention should be given to reviewing current literature in zoology, and I am told that the need is greater in some other sciences. It is not necessary to dwell upon the small number of universities in which the library facilities may be called good, upon the fact that our students are slow to gain a ready knowledge of the three or four foreign languages in which appears an increasing volume of scientific literature, or upon the heavy duties in teaching and administration with which our staffs of instruction are burdened. These conditions make reviews of literature especially useful to American men of science. There are, however, more fundamental reasons why the scientific body should pay more (and more serious) attention to reviewing its recent work. The first is that scientific efforts are very manifold and diverse and the output is very great and increasing. Beyond a certain limit, without an increase in the unifying forces, these efforts are bound to become discrete and diffuse. I believe that this limit has been reached. That the same belief is held in Europe is perhaps to be inferred from the great increase in reviewing in the last few years in Germany.

A second reason is that the review should be an important means for the training of investigators, and for leading students to become investigators. This function of the review has, I believe, not been sufficiently recognized, and it is this which especially interests us in America. By reviews the writer does not mean abstracts, which seek to furnish information by a short and easy method. Reliance on abstracts impoverishes and blunts the mind and is dangerous to the true spirit of investigation. Reviews which are essentially abstracts of isolated papers are of doubtful value. Because isolated, they do not aid the student in gaining a broad and fundamental understanding of the field; because abstracts, they can not be relied upon by the investigator; and they are longer than necessary to serve as a guide to the literature.

There are two ways in which reports or reviews may serve a useful purpose: first, as an annotated bibliography or guide; second, as a comprehensive presentation of the work done in a given field. These two legitimate kinds of reviews are quite distinct in their form and purpose. The annotated bibliography is useful to the specialist and instructor. For those who have not a large library at their disposal a mere list of titles is insufficient. It is necessary in addition to have certain information about a paper in order to know whether it is important for one's immediate purpose. It is greatly to the credit of Mr. Field that some of this information has been included in the Zurich bibliography. Fuller information is given in several journals of the *Centralblatt* type in Germany. In America in a special field the same kind of work is being done by the *Journal of Comparative Neurology and Psychology* through the joint efforts of its collaborators. Whether other journals might not well undertake similar work in their fields may, perhaps, better be discussed by others. In no journal with which I am acquainted are the reviews uniform in character or restricted to the kind of information here suggested. To make my meaning clear I may enumerate what, in my opinion, should be included in these brief reviews. Besides the author, title, date and place of publication, number of pages, figures and plates, and price of a book, there should be stated: (1) the material and methods, (2) the subjects treated, (3) the general purpose aimed at or end attained and (4) the reviewer's judgment as to the adequacy of the methods and the reliability of the results, in cases where the paper can be definitely characterized. Such reviews might occupy from six to twenty lines and when printed over the reviewer's signature would constitute a valuable guide for the advanced student and instructor.

The second form of review is useful to the instructor and should be especially valuable to the student who is pursuing his first piece of investigation or who is about to choose his subject. Probably no one thing would bring greater or surer return in the way of the advancement of science than an adequate means of introducing students to the original literature of their respective subjects and helping them to appreciate the historical perspective and the current tendencies of thought. This can not be done by reviews of isolated papers, nor to any great extent in courses of instruction. It can be done where a large enough number of students come together in a journal club or seminar, but best of all by the historical and critical review. The student is usually left to gain a practical knowledge of the literature in connection with his first piece of research, and thus suffers in two ways. First, a large amount of time is consumed in learning how to handle and judge the literature, which could be saved *in part* by an acquaintance with specimens of critical treatment. Second, he has not time in this way to gain a knowledge of many subjects. If he had at command before beginning research critical reviews of the several branches of his science he would certainly be able to choose a line of research more wisely, and would be in a better position to follow up the literature of fields other than his own. With our present method of instruction such reviews could very well serve as text or reference books to accompany lectures. They could be more accurate and better brought up to date than present text-books and would serve the purpose better for all except elementary students. Such reviews should aim to give the development and present status of the subject treated by means of a summary and criticism of the literature. The wide knowledge and judicial attitude necessary require that they be written by men who have completed more than one considerable piece of investigation and have had successful experience in teaching.

Granting the value of such reviews, two objections will doubtless be made. First, such work is already being done in Germany and we profit by it. Second, it is very difficult for an American university man with his manifold duties to accomplish such a piece of work as a historical review. Few men will be found willing to devote such time as they have to this in preference to investigation. With regard to the first objection, it would also be true to say that this work is being done in Germany and we lose by it. By this I mean that a great deal of good American work is either overlooked or misjudged by Europeans. Reviews written by capable Americans under favorable conditions would be more complete and better balanced and would be more useful to the American student. It should be remembered that the prospective or beginning investigator in our universities has yet to gain such facility in German that a Referat of a hundred or more pages shall be a delight to him. However, putting comparisons aside, there is room for reviewing in addition to that to be found in foreign languages, and I would not advocate the repetition in English of work which was already done in another language.

The second objection calls for a plan whereby we can secure such work by capable men under favorable conditions. Considering that critical work involving the organization of many details requires maturity of thought, a review of this kind must be the work of several months for an experienced investigator. A working year should be allowed in order that original investigation may be carried on at the same time. The best work would be done by men appointed each for a single review in his special field. The stipend should be liberal, say fifteen hundred dollars. The ground covered would be some well-defined field in one of the natural sciences. Whether such a review would be prepared each year in some field of each science or less often would be determined by the board who had the matter in charge. With regard to financial support and administration, the writer can only suggest possibilities. The first thought is that the Carnegie Institution might well do this work unless the terms of the foundation prevent. Or, a special endowment for this purpose might be given by some man interested in scientific progress. Or, the American Association for the Advancement of Science might secure a fund and appoint a board to carry on the work. Or, finally, since the universities are the chief means for the advancement of science and since the results would have direct relation to the work of instruction, a plan might be devised by which a number of universities would jointly provide for it.

In conclusion, if this be thought worthy of further discussion, let the motive of the writer's suggestion be clear. It is the advancement of science in America by means of organized reviewing of current literature as an aid in the development of the future investigator. This may be regarded by some as in the nature of 'coddling' which would lead into scientific work those who are unfit and who would not succeed. No one is less inclined than the writer to give undue encouragement to students. On the other hand it is an open question whether science is not now losing fit persons for want of some such introduction to the workshop. It is not desired that the literature should be brought down to the level of the average student. The reviews should be written for the serious man who is seeking his proper place and the opportunity to do work.

J. B. Johnston.

Naples,
November 29, 1904.

THE ORIGIN OF CYCLONES, TORNADOES AND COLD WAVES.

To the Editor of Science: As it seems still to be held that the origin of cyclones, tornadoes and cold waves is matter of debate I beg to offer a résumé of an article on that subject contributed some twenty years ago to the *Educational Courant* of Louisville, Ky., and which at the time received somewhat extensive notice.

The contention of that article was that cyclones arise exclusively over tropical islands. It is quite obvious that the movement of the atmosphere over every island that has a seabreeze as well as above every local fire, must be cyclonic. The vast majority of such cyclonic movements disappear with the reversal of the breeze which occurs at night. But now and then, under particularly favoring conditions, it happens that over a tropical island the cyclonic movement gains such force as to enable it to ascend to a great altitude, and this results in such concentration of vapor and consequent evolution of heat as to supply a new force for the continuation of the movement.

Now the trade winds on their equatorial border describe a loop, while passing from the southwesterly movement below to the northeasterly above, in such way that the wind in those situations may be very swift at considerable altitudes over regions of calm below.

Say one of the daily cyclones described arises over one of the Cape Verde Islands off the coast of Africa, or over one of the Windward islands, and let the conditions be such that when the cyclonic movement attains a considerable height it is caught in the loop of the trade winds moving to the westward. It will be carried to the west along the southern border of the loop, the strength of the southerly flow of the trade winds being sufficient to prevent the upper return or northerly flow from carrying it to the north. But in the course of its journey it enters a region where friction due to the continental mainland has largely interfered with the trade winds, and which interference has resulted in a weak movement of the trade winds of the surface as compared with the return winds above—this retardation after the cyclone has turned and begun its journey to the eastward. There must then be some close connection between them; a connection that would suggest the relation of cause and effect. But how can the low produce the high and its resulting cold wave. If we take into consideration the three facts that the cyclone itself is moving eastward at the rate of 20 or more miles an hour; that at the same time it is revolving contra-clockwise so that its northern segment has a potential westward movement of thirty or forty miles per hour; and, third, that there is a constant eastward movement of the upper strata of the atmosphere at a rate of perhaps seventy-five miles per hour—the situation becomes much simplified.

The periphery of the cyclonic mass on its northern side, moving as it does to the west, meets the air of the constant eastward current and backs or dams it up, thus producing the high almost invariably observed on the northwestern quadrant. The air thrown or carried up through the funnel of the cyclone remains in this situation more than in any other part of the region corresponding to the circumference of the cyclone. For to the south at this high level the translatory and rotatory movements correspond to and in a large measure neutralize each other. To the west the current of the cyclonic mass is transverse and not counter to the constant overcurrent, and besides, the flow having just emerged from the great friction of the northern side, has had its mass deeply shorn when it leaves the northwestern quadrant. On the eastern aspect, the masses of air carried up and thrown out by the cyclone move onward even at a more rapid pace with the overcurrent and are carried out of the way, giving rise to the cirrus clouds usually seen under such circumstances. A high then must accumulate on the northwestern quadrant. As soon as the cyclone has passed any given point, the 'high' begins to flow out in obedience to the laws of equilibrium. To the east it is hindered by the snarly cyclone. To the north it is hindered by the conservation of areas due to the narrowing meridians and perhaps the undertow equatorward. To the southeastward, then, it must escape into the depression created by the passing cyclone.

The blizzard.—If this outflow of the high finds a lofty and long range of mountains running north and south, these will behave as one of the banks of a great river or one side of a river bed in causing the mass to take on a spiral form of movement. By this movement the atmosphere will be continuously climbing obliquely up the mountains on the western side, while on the eastern border of the spiral the cold dry air will be as continuously drawn down from the upper regions. The western blizzard is such a current, and the Texas norther its continuation.

The great majority of our cyclonic 'laws,' however, do not originate in the tropical north Atlantic, but in the tropical north Pacific. They arise over the innumerable islands found in that region, move west till deflected by the Asiatic mainland, carrying rain and moisture to various distances inland, and then they veer around till, caught in the eastward overcurrent, they are carried eastward across the Pacific, the American continent and often across the Atlantic, and far into the eastern hemisphere again before being arrested.

This is not to deny that cyclones may be formed in other ways, though it may be hard to see how; but since cyclones without number are formed over tropical islands ready to start on their travels, how else can it be than that some of them are caught up in the way described and borne away on their earth-girdling journey? D. T. Smith.

SPECIAL ARTICLES.

A CONTRIBUTION TO THE HISTORY OF THE CONTROVERSY OF FLAMSTEED WITH NEWTON AND HALLEY.

The library of the United States Military Academy at West Point owns a fine copy of Flamsteed's 'Historia Britannica Cœlestis' (London, 1712) which is without any manuscript notes or corrections. To one of the fly leaves a single folio leaf was fastened: 'An estimate of the number of folio pages that the Historia Britannica Cœlestis may contain when printed,' which is dated 'The Observatory, Nov. 8, 1704.' On the blank side of this leaf is written, by Flamsteed himself, the words: 'Mr. Flamsteed's Estimate.' The printed folio page is set up in paragraphs, and Flamsteed has written comments opposite to many of them. As other copies of the 'Historia Britannica Cœlestis' probably contain this folio estimate, I will copy here the MS. comments only, not the paragraphs to which they refer.

The first seven lines of paragraph 1 refer to Gascoigne's observations; they are enclosed by a MS. brace; Flamsteed's comment is:

These are not yet printed, being reserved to be inserted in the preface.

The last four lines of paragraph 1 refer to observations of eclipses, Jupiter's satellites, sun-spots, comets, etc., taken with a large sextant, etc., between the years 1675 and 1689 at Greenwich; they are enclosed by a MS. brace; the paper at the margin is torn here, but I make out Flamsteed's comment to be:

Printed at his Mr. John (leaf torn)
charge on bad paper (leaf torn)
not so correct as they ought (leaf torn)
in 100 sheets.

The second paragraph relates to meridional distances, transits, etc., observed between 1689 and 1704. A brace encloses its four lines, and Flamsteed's comment is:

A fair copy of these on 175
sheets was put into Sr. Is. New (paper torn)
hands Mar. 20 1707/8 to be printed.

N. B. The figures that give the year are here somewhat doubtful, but see below.

The third paragraph is divided into numbered sentences. The first seven relate to Ptolemy's and other catalogues of stars; they are included within a MS. brace; Flamsteed's comment is:

These be ready to be transcribed.

Sentence 8 of paragraph 3 (5 lines) relates to the British Catalogue of 3,000 stars; a MS. brace encloses it; Flamsteed's comment is:

These are printed at my own charge.

N. B. The wording here makes it evident that the MS. notes in this handwriting are by Flamsteed himself.

The next four lines of the text have no MS. comment, but the succeeding three are printed as follows:

"The New Figures of the Constellations, or the Ancient Ones restor'd (those in *Bayer,* and on our Globes being false, and different from all the Catalogues in all Languages) in about Sixty Copper Plates, each near Two Foot broad, and Twenty Inches deep, with a Preface."

This sentence is enclosed in a MS. brace and Flamsteed's comment is:

These were altogether necessary and
ought to have been first taken
care of but were designedly
neglected by Sr. Is. N. to spoyle
ye whole.

The next printed words relate to part first of the proposed book. A MS. mark refers to the foot of the page where Flamsteed's MS. comments are written, as follows:

The first part was printed off in October 1707. March 20 1707/8 Sr. Is. Newton had 175 sheets put into his hands to be printed, of which what is become J. F. knows not, save that E. Halley has printed some sorry Abstracts of a part of them without J. F's knowledge and consent.

At the foot of the page are two MS. queries by Flamsteed, as follows:

1. *Qs. What is become of £1200 allowed for ye work per Prince George.*
2. *What is become of all Copies already Printed.*

At the foot of the page there is a line of MS. written by another hand in a different ink, as follows:

Memdm. J. F. told W. L. at ye Treasury Office that E. H. had stolen 2 or 3 of his best fixed stars.

Those who wish to follow the rather complicated quarrel of Flamsteed with Newton and Halley can find a sufficient and fair account of the controversy in the 'Dictionary of National Biography,' Vol. XIX. (Article Flamsteed—see also Newton and Halley). It is of extreme interest to have found Flamsteed's own comments on the controversy. The MS. referred to has, by direction of the Superintendent U. S. M. A., been deposited with the Royal Society of London, which possesses many of the manuscripts of Flamsteed, Halley and Newton.

Edward S. Holden.
U. S. Military Academy.

A BETWEEN SEASON BIRD FOOD SUPPLY.

An apparently unnoticed food supply for birds is found in the heaps of drift, the flotsam and jetsam cast up along the shores of rivers, creeks and other bodies of water. These places are much resorted to by crows, jays and blackbirds, and probably most of the sparrows feed about them from time to time. As they exist during the winter and early spring when food is not easily accessible over the whole country, they are probably welcome stores to our winter birds.

In order to ascertain the character and quantity of available bird food in these drift heaps I filled a half pint tin can with the material, scraping it in at random from the surface of one of them. Besides the bits of bark, twigs, leaves, etc., I found in this quantity of the drift, by actual count, 1,583 seeds and fruits of more than 55 species of plants. These are without exception substances which have been found in the stomachs of birds. What a rich variety of food there is in the drift heaps, and what a truly enormous quantity there must be in the cast-up material which lines the shores of all of our waters. Besides the vegetable matter there were also several insect pupæ and a few living chrysomelids and weevils.

The following seeds and fruits were contained in a half pint of drift collected along Northwest Branch, Montgomery County, Md., March 19, 1905: Tulip-tree (262), pigweed (199), purslane (145), cowbane (124), elderberry (108), witch grass, etc. (98), oats (75), black mustard (74), common ragweed (51), sedges of genus *Carex* (44), buttonweed (39), pale persicaria (38), *Polygonum* spp. (35), lamb's quarters (31), spotted spurge (31), blackberry (28), great ragweed (21), green foxtail (18), yellow sorrel (18), beaked rush (17), yard grass (17), white ash, (12), mountain laurel (10), rice cut-grass (9), pokeweed (8), sedges beside *Carex* (8), black bindweed (7), Pennsylvania persicaria (6), aster (5), alternate-leaved dogwood (4), basswood (4), tubers of sedge (4), wild turnip (3), cockspur grass (3), broad-leaved dock (3), kinnikinnik (3), water oak (3), summer grape (3), green ash (2), touch-me-not (2), broad-leaved arrowhead (2), poison ivy (2), *Paspalum* sp. (2), water plantain (2), cocklebur (2), nightshade (2), corn cockle (1), bloodroot (1), scarlet sumac (1), spiderwort (1), beggar's ticks (1), mulberry (1), pine (1), spatterdock (1), sourgum (1).

W. L. McAtee.
Biological Survey,
Washington, D. C.

AN UNDESCRIBED ALTERNARIA AFFECTING THE APPLE.

An apparently undescribed species of *Alternaria* was found on a single specimen of apple a year ago while the writer was investigating apple rots at the Michigan Agricultural Experiment Station. On coming to this place the same fungus was found to be one of the most common causes of rot in apples in the state of Colorado. Professor W. Paddock, of the Colorado Experiment Station, had already done some work with this fungus.

The disease manifests itself by attacking the blossom end of the fruit, causing a decayed area of a very dark brown color. This area may remain quite small or it may gradually enlarge until the whole fruit is involved, after which the decayed specimens dry down to a shrivelled, hard mass. The fungus appears to affect different varieties to an unequal degree, some apple growers having reported that it is almost impossible to secure ripe fruit of certain kinds because of the attacks of this disease. In other cases it has been found associated with a blackened condition of the seed cavity in ripe fruit, the carpels being much discolored on the inner side. This condition may also be accompanied by a kind of core rot due to the invasion of the flesh around the carpels by the fungus.

Inoculation experiments are being carried on with a view to determine other possible hosts, as well as the characteristic effects of the fungus on the apple.

The fungus is apparently carried through the winter on portions of the flowers and fruit that were attacked by the fungus during the preceding season and which are still attached to the trees. Reports indicate that the fungus can be readily held in check by spraying with Bordeaux mixture.

B. O. Longyear.
Agricultural College Experiment Station,
Fort Collins, Colo.,
January 18, 1905.

ON THE USE IN SURGERY OF TENDONS OF THE ARDEIDÆ AND GRUIDÆ.

The subject of sutures and ligatures and their proper sterilization and use has long been an important subject in the realm of modern surgery. Various materials have from time to time been recommended, many to drop by the wayside, and we find even in the materials of the present day, namely, catgut, kangaroo tendon, silk, silkworm gut, horse hair and silver wire, great difference of opinion in the minds of surgeons as to their use.

The recent introduction* by Dr. Kieffer of an entirely new material will be of much interest to the surgeon, but it likewise will be of no less interest to the American ornithologist. Dr. Kieffer found after a series of experiments that the tendons of the Ardeidæ and Gruidæ made an excellent suture and ligature and, moreover, that they seemed to possess some advantages over the present materials, principally kangaroo tendon and catgut. The flexor and extensor tendons of the great blue heron (*Ardea herodias*) were first made use of, and later those of the sand hill crane (*Grus canadensis*) and whooping crane (*G. americana*). The tendons were readily made aseptic by the Claudius method of sterilizing catgut.

Regarding his experiments Dr. Kieffer says: "There is still room in the armamentarium of the surgeon for a reliable, slowly absorbable suture and ligature material. I have been recently investigating a material which I believe to be entirely new. Dr. Geo. P. Johnson, of Cheyenne, called my attention to the long and strong tendons in the legs of the bird commonly known throughout the United States as the blue crane. He had used this material with excellent results as a suture for the aponeurosis in a case of hernia, the suture giving no trouble and apparently being absorbed in time. I obtained from him a number of these tendons and immediately began a series of experiments to test their value. * * * As a result of these studies I have come to the conclusion that we have not only a valuable suture and ligature material, but one easily obtained in all parts of the world." It is to be wondered that the tendons of the larger grallatorial birds were not long ago thought of as suitable material for surgical purposes. Dr. Johnson is to be commended for his originality.

Thus the herons and cranes are given an economic value which unfortunately must further add to their destruction. Think of the thousands of these birds which would have to be killed annually should this material be adopted for ligature and suture purposes by even a small proportion of our American surgeons.

It is the least of my desire to criticize the author above referred to. His well-conducted experiments are commendable, but only to voice a word of warning to what at present might prove the extermination of the larger members of two great families of birds.

Unlike the Anseres (ducks, geese, swans) and members of the order Gallinæ, notably the bob-white (*Colinus virginianus*), the members of the Ardeidæ and Gruidæ are far from prolific breeders. Members of the latter-named families rarely lay over five eggs, while certain ducks lay as high as fifteen and the bob-white often more than twenty. Moreover, the latter two species often raise more than one brood in a season, and it is doubtful if the herons and cranes ever do. This will partially account for the survival of the game birds in spite of the inroads caused by gunners. Furthermore, herons build in colonies termed heronries, so that once the breeding place is located their capture is made easy. Thus the herons (*A. herodias*) of any one county of Michigan, for instance, might be exterminated by one hunter in the course of a season, should there be demand.

Unlike a great proportion of our American birds, little can be said of the economic value of members of the above-mentioned families, either as benefactors to agriculture as insect and weed-seed destroyers, or as articles of food.

A plea for the herons and cranes then can be made solely on sentimental grounds. It is their esthetic value, not as songsters, but their beauty, the grace which their presence adds to the landscape of the various portions of our continent. The history of a departing race is always a sad one and, judging from the thousands of dollars which are spent annually on our zoological gardens, we are inclined to believe that our people admire rather than desire to exterminate any of our native fauna. Truly the places occupied by our herons and cranes is a typical one, and as ornithologists we should aim to preserve rather than destroy.

Already some members of the tribe have

* 'A New Material for Sutures and Ligatures,' Charles F. Kieffer, M.D., *Jour. Am. Med. Assn.*, 1904, pp. 1519–1522.

been driven to the verge of extermination by the plume hunters. A strong public sentiment has been raised of late in favor of these species, not only in this country, but in various countries of Europe. Under the present conditions the organized bird protectors of this country, the Audubon societies, had looked for an increase in these species under our more recent laws regarding birds, but it is plain to see that should the tendons become popular with our surgeons for ligature and suture purposes the birds might have a still greater enemy. I do not consider the statement sweeping when I say that the extermination of some species would be only a matter of time.

However, as the author concludes: "Think of the comfort to the civil or military surgeon in isolated places of knowing that he can have a suture material at the end of his shot gun."

Alexander W. Blain, Jr.
Detroit College of Medicine.

NOTE ON THE OCCURRENCE ON GRAIN OF ORGANISMS RESEMBLING THE BACILLUS COLI COMMUNIS.

It is a well-known fact that bacteria exhibiting the reactions of the *Bacillus coli communis* are widely distributed in nature, being found even on material least liable to pollution from any animal sources. Thus Prescott* has shown the occurrence of colon forms in wheat flour, corn meal, breakfast foods and various other food-stuffs only remotely liable to infection, as they are handled only on the large scale and in the open field or large mill. He also demonstrated their constant presence on certain grains—oats, barley, rye, wheat, buckwheat—taken directly from seed-warehouses and stores but slightly liable to contamination. Papasotiriu† has also demonstrated the presence of such forms on grains, showing them to be commonly present when small numbers of grains were studied. In his investigations cultures of ten kernels each of wheat, rye, barley, oats, peas, beans and corn were made in dextrose broth in triplicate, fourteen out of the twenty-one cultures giving positive results. The presence of these simulating forms in dough and articles manufactured from the hexoses has been studied carefully, especially by Lehmann and his pupils;* since, however, during the preparation such food-stuffs could become readily infected by the necessary handling, the results have less importance from the sanitary standpoint.

During the past months I have made some further investigations to determine whether bacterial forms simulating closely in their behavior the *B. coli communis* were present on grain which in all probability could not have become contaminated by direct contact with fæcal matter. In all investigations thus far reported some doubt may be cast on the integrity of the samples, or at least there is a possibility of contamination from handling or manufacture. In November, 1904, a field of rye was found in western Massachusetts which, owing to the scanty growth, had not been cut. The field is on light soil, on a level, open, sandy plain, and stands well back from a country road not heavily traveled. Inquiry showed that the field had not been fertilized and that no cattle had ranged through the grain during the fall. This stand of grain, therefore, may be taken as a typical open country growth free from contaminating influences. From this field heads of grain were picked with sterilized forceps and put into sterilized glass tubes. These heads were incubated separately in bouillon for twenty-four hours and then differentiated out through lactose-litmus-agar into pure culture, following the usual procedure. At the first test eight heads were thus treated and one gave abundant growth of an organism which repeatedly showed the characteristics of *B. coli communis,* and allied groups of organisms, solidifying and decolorizing litmus milk, giving a white expansive growth on agar, a heavy growth in bouillon, fermentation in dextrose broth with fifty to eighty per cent. gas production, fermentation in lactose broth with thirty to forty per cent. gas production, heavy indol reaction, heavy reduction of nitrate and a dirty yellowish growth on acid potato.

* Science, New Series, Vol. XV., No. 375, 1902, p. 303.

† *Archiv für Hygiene*, 1902, Vol. XLI., pp. 209–210.

* See papers in *Archiv für Hygiene.*

On December 10 a second lot of heads was secured in the same manner from the same field, and fifteen heads were treated as before; of these, four different heads yielded organisms exhibiting the above reactions characteristic of the colon group, the gas from the dextrose fermentation tubes in this series being more nearly that of the true colon type, varying from thirty to fifty per cent. and with a ratio of two to one.

On January 11 eleven more heads which had been kept in the glass tubes in the laboratory were subjected to the same procedure and one gave exactly the reactions of the *B. coli communis.* In all, therefore, at different times thirty-four heads from this field of rye were studied and from six of them organisms were isolated giving the reactions of the colon bacillus with the ordinary media. It will be recalled that these heads were taken at random over the whole field after they had stood through the storms of the fall, and snow of the early winter. Other heads of the rye gave indications of these acid forms, but did not exhibit the reactions typical of the colon group of organisms so decisively as those included above.

These results possess considerable interest from both the theoretical and practical standpoints. The question as to their origin first naturally arises. It is evident that either: (*a*) Colon forms must have been transported through the air as dust or carried by insects contaminated with animal excrement and thus deposited on the grain; or, (*b*) on these grain heads bacteria normally occur which in the several cultural processes exhibit most marked resemblances or absolutely correspond to the *B. coli communis,* or the colon group.

On the first assumption it is difficult to explain the persistence of these forms on grain, and especially on so large a proportion of the heads of grain distributed over an unfertilized field far removed from travel. If, however, this view be untenable, the other proposition must be accepted, viz., that forms of bacteria occur on natural grains closely resembling in their habit the distinctively fæcal forms, and which in our present methods of study can not be distinguished from them. It is extremely suggestive that these forms are so commonly present on most of the cereals thus far studied, being found even, as shown above, on standing grain before its harvesting, with the probabilities so against any contact contamination.

Further, the relation of these forms to the study of the pollution of natural waters is of the utmost importance. Whatever may be the source of the original seeding individual, the fact of their presence on the grain-heads suggests sources for the so-called colon bacilli in streams other than direct sewage pollution, and the presence of such 'colon forms' must be interpreted most carefully. Certainly the old hard and fast rule concerning the significance of the presence of *any* 'colon forms' as *prima facie* evidence of sewage pollution must needs be most discriminatingly applied.

It is unfortunate that the season of the year and locality where these experiments were carried out requires the postponement of further investigation until another season. Meanwhile the writer would value any suggestions or data bearing on this study, especially from the agricultural experiment stations, the publications from which may contain researches on these grain organisms which thus far have not fallen under his notice.

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CURRENT NOTES ON METEOROLOGY.

ALTITUDE AND ACCLIMATIZATION IN THE TROPICS.

In a recent summary of the 'Report of the Census of the Philippines' (published April 8) which appears in the *National Geographic Magazine* for April, 1905, the following sentences are found: "That long exposure to the climate is enervating there can be no doubt, but the effect is easily avoided by periodical changes to a colder climate. This has been conclusively proven by the old Scotch, English and other white residents, who, after a residence of over forty years, broken by such removals, enjoy excellent health. Formerly it was necessary to take a sea voyage in order to find relief, but with the completion of the electric railroad at Baguio, in the province of Benguet, this will no longer be needful, *as the climate at that altitude will afford the requisite change*." (The italics are those of the compiler of these notes.) A study of the experience of European nations in the tropics leads to a much less optimistic view than that here set forth. Mountain stations, such as Baguio, are important, because they furnish some relief from the heat and humidity of the lowlands, and are above the zone of many tropical diseases, but they *do not solve the problem of acclimatization*. It is the monotony of the climatic conditions in the tropics which is one of the chief difficulties. The 'spur of the seasons,' which is so important an influence in giving the northern peoples their vigor and energy and 'push,' is lacking in the tropics. No mountain climate can supply this missing quality. A change to a colder latitude alone can do it.

THE NEW CAPITAL OF ERITREA.

Climatic considerations have been the determining factor in bringing about the selection of a new capital for the Italian colony of Eritrea. The government offices have hitherto been at Massowa, on the Red Sea, where the climate is very trying. The present plan is to remove the seat of government to Asmara, on the high plateau of the hinterland, sixty miles in the interior, and 7,800 feet above the sea. Asmara is above the zone of the typical tropical diseases.

THE CLIMATE OF BALTIMORE.

Part 1 b, Special Publication, Vol. II., Maryland Weather Service, 1905, of a 'Report on the Climate and Weather of Baltimore and Vicinity,' by Dr. Oliver L. Fassig, has been issued. Part 1 a was recently mentioned in these notes. The present volume deals with humidity, precipitation, sunshine and cloudiness, winds and electrical phenomena, is a very thorough study, and contains abundant illustrations.

MONTHLY WEATHER REVIEW.

The Monthly Weather Review for December, 1904 (issued February 28, 1905), contains articles of general interest as follows: A review of Woeikof's new text-book of meteorology, by Dr. Stanislav Hanzlik (unfortunately this book is in Russian); a summary of the work done at the Aeronautical Observatory at Tegel, near Berlin, from October 1, 1901, to December 31, 1902; 'Evaporation Observations in the United States,' by H. H. Kimball (read before the Twelfth National Irrigation Congress, El Paso, November 16–18, 1904), accompanied by a chart showing lines of equal depth of evaporation in inches from a free water surface, computed from observations between July, 1887, and June, 1888; 'The Storm and Cold Wave of December 24 to 29, 1904,' by W. J. Bennett; 'Some Relations between Direction and Velocity of Movements and Pressure at the Center of Ellipsoidal Cyclones,' by Dr. Stanislav Hanzlik; 'Nitrogen in Rain Water,' 'The Vapor Pressure of Mercury,' 'Kite Work by the Blue Hill Observatory and the U. S. Weather Bureau.'

R. DeC. Ward.

MEMORIAL OF THE OHIO ACADEMY OF SCIENCE ON THE DEATH OF PROFESSOR A. A. WRIGHT.

The executive committee of the Ohio Academy of Science has adopted the following memorial prepared at its request by Professor Lynds Jones in respect to the death of Professor A. A. Wright, of Oberlin, a member and a former president of the academy.

Albert Allen Wright died at his home in Oberlin on April 2, 1905, of acute peritonitis after an illness of scarcely twenty-four hours. Professor Wright was graduated from Oberlin College in 1865, received the degree of A.M. from Oberlin in 1868, the degree of Ph.B. from the School of Mines, Columbia College, 1875, was professor of mathematics and natural science at Berea College, Kentucky, 1870–73, and was called to the chair of geology and natural history of Oberlin College in 1874. With the change of title to professor of geology and zoology his service at Oberlin has been continuous since his first appointment.

Professor Wright was born in Oberlin in 1846. He served as a 100-day man during the closing days of the rebellion, and received his baccalaureate degree the following year at the age of nineteen. He began early to develop his natural taste for science, and soon became recognized as a safe scientific thinker and investigator. He was one who never rushed to conclusions however enticing the facts discovered appeared, but took time to look into every possible avenue of approach to the subject, being satisfied only when his conclusions rested upon a foundation that could not be shaken. Consequently he was not a prolific writer. Indeed, he gave himself so unreservedly to his teaching and his students that research work was possible only during his brief vacations and at odd hours.

Professor Wright was a modest, retiring man, always shrinking from publicity, yet his service to the community and the state becomes conspicuous in his absence. Oberlin's unrivaled water and sewer systems are largely due to his hard study and keen insight. To him is almost wholly due the inception of the topographical survey of Ohio. In this he was at first defeated, but by untiring efforts and dogged determination saw the issue to a successful finish. He was also among the charter members of the Ohio State Academy of Science, which he served as president.

Probably among his most conspicuous contributions to science was his correction of Dr. Newberry's error in the true arrangement of the ventral armor of *Dinicthys*. While the publications over his own name were relatively few, his inspiration to others and his constant interest and unfailing kindness in spending himself for others who worked under him will continue long to be a potent factor in the advancement of science.

Professor Wright was a fellow of the American Association for the Advancement of Science, a fellow of the Geological Society of America, and member of the Ohio State Academy of Science.

Herbert Osborn, *President*,
L. B. Walton, *Secretary*.

THE NEWFOUNDLAND WHALE FISHERIES.

The returns of the Newfoundland Whale Fisheries for 1904 show that the eleven steamers employed took 1,270 whales, or an average of 116 each. In 1903 four steamers took 859 whales, or an average of 215 each. The Fisheries' 'Gazette' says that these returns make a very unfavorable showing and that comparison with those for 1903 is most depressing. That it is so is only what might have been expected. One can take out of a bucket only as much water as there is in it, and with the present rate at which whales are being killed, there is no reason to expect that the supply can at all keep up with the demand. Of course local causes may have been responsible for a part of the decrease, but this remains to be seen, and certainly a catch of 1,200 whales in the limited area around Newfoundland must be looked upon as enormous.

Those familiar with the history of fishing industries are quite aware that the fishermen never admit that their catch has any influence whatever upon the diminution in numbers of animal life; whales, seals and fishes are never exterminated, simply gone elsewhere, although that elsewhere is invariably where the wicked men cease from troubling and the weary animals are at rest.

The question is now being agitated as to what effect the diminution of whales will have upon other fisheries and in Norway the agitation carried on by the fishermen has progressed to such an extent that, right or wrong, the whale fishery in certain districts has been prohibited. That the diminution of whales may have an effect on fisheries is very probable, though it is extremely doubtful if the reasons assigned by the fishermen are the correct ones.

On the Newfoundland coast the whales feed entirely upon small isopods and it may be that the diminution in whales allows a wonderful increase of the *Euphausia*, who in turn feed upon the minute life on which the caplin and herrings are accustomed to feed. That the whales directly affect either herring or caplin or squid is more than doubtful, since none of these animals form any portion of the food of whales on the Newfoundland coast. Of the hundreds of whales examined none have contained anything save *Euphausia*. The smaller finback whales, such as *Batænoptera acutorostrata*, feed actively upon the schools of caplin, but this species is not common about the Newfoundland coast and certainly has no appreciable effect upon the fishes.

F. A. L.

Brooklyn Institute Museum.

CONFERENCE OF ANATOMISTS AT THE WISTAR INSTITUTE.

Ten of the leading American anatomists were invited by the Wistar Institute of Anatomy of Philadelphia to take part in a conference held at this institute on Tuesday and Wednesday, April 11 and 12, to consider with the management of the Wistar Institute the question of increasing the usefulness of the Wistar Institute to American anatomists by establishing relationship with the individual anatomists of the country, with the Association of American Anatomists, with the *American Journal of Anatomy* and with similar institutes abroad; and also by establishing an Advisory Board of Anatomists of the Wistar Institute, with ten or more members, selected from the leading anatomists of the country.

The following anatomists were present at the conference:

Dr. Lewellys F. Barker, professor of anatomy, University of Chicago, Chicago, Ills.

Dr. Edwin G. Conklin, professor of zoology, University of Pennsylvania, Philadelphia, Pa.

Dr. Henry H. Donaldson, professor of neurology, University of Chicago, Chicago, Ills.

Mr. Simon H. Gage, professor of embryology, Cornell University, Ithaca, N. Y.

Dr. G. Carl Huber, professor of embryology and histology, University of Michigan, Ann Arbor, Mich.

Dr. George S. Huntington, professor of anatomy, Columbia University, New York City.

Dr. Franklin P. Mall, professor of anatomy, Johns Hopkins University, Baltimore, Md.

Dr. J. Playfair McMurrich, professor of anatomy, University of Michigan, Ann Arbor, Mich.

Dr. Charles S. Minot, professor of embryology, Harvard Medical School, Boston, Mass.

Dr. George S. Piersol, professor of anatomy, University of Pennsylvania, Philadelphia, Pa.

The first formal meeting was opened in the library of the Wistar Institute at 11 o'clock Tuesday morning. General Wistar, the donor of the institute, representing the board of managers, addressed the meeting and expressed his pleasure at having such a distinguished body of scientists present. He then spoke of the organization of the institute, its objects, its resources and its probable future.

Dr. M. J. Greenman, director of the institute, followed with a short address outlining the work which he thought might be accomplished by the conference. The objects and possibilities of the institute were stated. Reference was made to its independent organization, on account of which it is in a position to accomplish certain lines of work which could not be undertaken by other institutions.

The anatomists were called upon to consider what special lines of work the institute might undertake, to be of greatest service to American anatomy, to consider the relations of the institute to the American Association of Anatomists, to the American anatomists as individuals and to the *American Journal of Anatomy.* They were also requested to consider the possibility and advisability of establishing a central institute of neurology, utilizing the Wistar Institute as its working base, and acquiring relations with the committee appointed by the International Association of Academies for Brain Investigation.

Attention was called to the achievements possible by cooperation of individuals and other forces with an institution organized and endowed for research anatomy.

The organization of an advisory board of anatomists of the Wistar Institute was suggested as a possible means of accomplishing the most work for the greatest number.

The conference then organized and elected Dr. Charles S. Minot chairman and Dr. M. J. Greenman secretary.

The discussion which followed resulted in a unanimous opinion that the Wistar Institute of Anatomy offered most unique facilities for defining American anatomy, facilities which would be of advantage to all investigators in this branch of science. It was thought that research material might be collected and prepared there, especially neurological and embryological materials, thus saving much time to the interpreter; that original preparations which had been studied and therefore, of much greater value, should be deposited in the Wistar museum for future use of students who wished to review the work. The reproduction of models was suggested.

The importance of organized effort to collect and properly prepare the vast amount of anatomical material which usually goes to waste and the importance of its immediate use while fresh were emphasized. The establishment of agencies in various localities with skilled preparators in charge for the collection of material was suggested. It was developed in the course of the discussion that the advanced grade of museum work which the institute strives to do and investigation are inseparable. It was considered that the pursuit of a well defined line of researches was necessary for the proper collection and preparation of materials. Neurology, embryology and comparative anatomy were discussed as the broad lines of work to be developed and it was thought that neurological researches should be the first to receive attention.

The first session was closed after having appointed a committee of three with instructions to formulate a series of propositions to be discussed at the morning meeting on April 12. The committee consisted of Chairman Minot, Dr. Donaldson and Dr. Mall.

The second session of the conference was called on Wednesday, April 12, at twelve o'clock; Chairman Minot presided. The committee presented its report, which is as follows:

"Notes taken at the meeting of the committee yesterday are presented in the following order: (1) The principal object of the institute to be research and under these headings: (*a*) a chief of investigation, (*b*) research assistants or assistantships and men who shall divide their services between the museum proper and research, (*c*) technical assistants. (2) Research and materials: (*a*) research shall be in the field of neurology, (*b*) comparative anatomy and embryology. (3) Relations: (*a*) committee recommends that the subvention to the *Journal of Anatomy* be granted, (*b*) committee be appointed to consider relations of the Wistar Institute to American anatomists, (*c*) the Wistar Institute to apply to the Association of American Anatomists for cooperation. (4) That an advisory board of ten be appointed for general purposes: (*a*) to form a subcommittee on neurology as well as other sub-committees that may be needed, (*b*) to establish relations with the committee of the International Association of Academies for Brain Investigation and with other committees for collective investigation, (*c*) the committee recommends that the board bear in mind that while the general trend of work above outlined is recommended there is no intention to advise limitation of the functions of the institute to it exclusively.

A brief discussion followed and the recommendations of the committee were unanimously adopted by the conference. Chairman Minot then presented these recommendations to the Wistar Institute as the finished work of the conference.

General Wistar thereupon expressed the approval of the Wistar Institute in every detail of the recommendations and asked the ten anatomists present if they would become members of a permanent advisory board of anatomists of the Wistar Institute and proceed to organize and appoint such committees as were recommended. General Wistar explained that he voiced the sentiment of the members of the board of managers present and he would assume authority for the creation of such a board and the appointment of its members and he had no doubt that the creation of the advisory board of anatomists and the personnel of its membership would be officially confirmed by the board of managers at its next meeting. The members of the conference consented and the advisory board was organized by electing Dr. Charles S. Minot as chairman and Dr. M. J. Greenman as permanent secretary.

The advisory board proceeded to appoint the following committees: on neurology and the establishment of relations with the International Association of Academies, Dr. L. F. Barker, Dr. H. H. Donaldson, Dr. F. P. Mall, Dr. J. P. McMurrich, Dr. C. S. Minot (this committee to elect its own chairman); on relations of the Wistar Institute to American Anatomists, Professor S. H. Gage, chairman, Dr. Geo. A. Piersol, Dr. G. Carl Huber; on comparative anatomy and embryology, Dr. Geo. S. Huntington, chairman, Dr. E. G. Conklin, Dr. F. P. Mall.

At the close of the meeting Dr. L. F. Barker was called upon by the conference to express its thanks to the Wistar Institute for the reception which was tendered the members of the conference and for the opportunity which they had had of taking so active a part in a plan of such broad and liberal scope. Dr. Barker called attention to the unusual procedure of an endowed institution extending its facilities in such a liberal manner to the workers in the science and calling upon them to advise methods of development which would be mutually advantageous to both the institute and researcher.

The meeting of the advisory board then adjourned subject to the call of the officers of the meeting.

A meeting of the board of managers of the Wistar Institute was called on April 18 and the action of its representatives at the conference was officially confirmed.

THE CARNEGIE FOUNDATION.

The announcement was made on April 27 that Mr. Andrew Carnegie had created a trust fund, to be known as 'The Carnegie Foundation,' to provide annuities for college professors in the United States, Canada and Newfoundland, who from old age or other physical disability are no longer in a position to render efficient service. The fund is vested in a board of trustees consisting in the main of presidents of institutions for higher education. It consists of $10,000,000 first mortgage 5 per cent. Steel Corporation bonds, the market value of which at present is $11,500,000, and will produce an income of $500,000 a year.

Mr. Carnegie's letter to the trustees is as follows:

New York, April 18, 1905.

Gentlemen: I have reached the conclusion that the least rewarded of all the professions is that of the teacher in our higher educational institutions. New York city, generously, and very wisely, provides retiring pensions for teachers in her public schools and also for her policemen. Very few indeed of our colleges are able to do so. The consequences are grievous. Able men hesitate to adopt teaching as a career, and many old professors whose places should be occupied by younger men can not be retired.

I have, therefore, transferred to you and your successors as trustees, $10,000,000 five per cent. first mortgage bonds of the United States Steel Corporation, the revenue from which is to provide retiring pensions for the teachers of universities, colleges and technical schools in our country, Canada and Newfoundland, under such conditions as you may adopt from time to time. Expert calculation shows that the revenue will be ample for the purpose.

The fund applies to the three classes of institutions named, without regard to race, sex, creed or color. We have, however, to recognize that state and colonial governments which have established, or mainly support, universities, colleges or schools, may prefer that their relations shall remain exclusively with the state. I can not, therefore, presume to include them.

There is another class which states do not aid, their constitutions in some cases even forbidding it, viz., sectarian institutions. Many of these, established long ago, were truly sectarian, but today are free to all men of all creeds or of none—such are not to be considered sectarian now. Only such as are under control of a sect or require trusteees (or a majority thereof), officers, faculty or students to belong to any specified sect, or which impose any theological test, are to be excluded.

Trustees shall hold office for five years and be eligible for reelection. The first trustees shall draw lots for one, two, three, four or five-year terms, so that one fifth shall retire each year. Each institution participating in the fund shall cast one vote for trustees.

The trustees are hereby given full powers to manage the trust in every respect; to fill vacancies of non ex-officio members; appoint executive committees; employ agents; change securities and, generally speaking, to do all things necessary in their judgment to insure the most beneficial administration of the funds.

By a two thirds vote they may from time to time apply the revenues in a different manner and for a different though similar purpose to that specified, should coming days bring such changes as render this necessary in their judgment to produce the best results possible for the teachers and for education.

No trustee shall incur any legal liability flowing from his trusteeship. All traveling and hotel expenses incurred by trustees in the performance of their duties shall be paid from the fund, the expenses of wife or daughter accompanying the trustees to the annual meeting included.

I hope this fund may do much for the cause of higher education and to remove a source of deep and constant anxiety to the poorest paid and yet one of the highest of all professions. Gratefully yours, Andrew Carnegie.

The trustees named by Mr. Carnegie, all of whom are said to have accepted, are as follows:

President A. T. Hadley, Yale University.

President Charles William Eliot, Harvard University.

President William R. Harper, University of Chicago.

President Nicholas Murray Butler, Columbia University.

President Jacob G. Schurman, Cornell University.

President Woodrow Wilson, Princeton University.

President L. Clarke Seelye, Smith College.

Provost Charles C. Harrison, University of Pennsylvania.

President Alexander C. Humphreys, Stevens Institute.

Chancellor S. B. McCormick, Western University of Pennsylvania.

President Edwin B. Craighead, Tulane University.

President H. C. King, Oberlin College.

President C. F. Thwing, Western Reserve University.

President Thomas McClelland, Knox College.

President Edwin H. Hughes, De Pauw University.

President H. McClelland Bell, Drake University.

President George H. Denny, Washington and Lee University.

Principal Peterson, McGill University.

President Samuel Plautz, Lawrence University.

President David S. Jordan, Leland Stanford Jr. University.

President W. H. Crawford, Allegheny College.

President Henry S. Pritchett, Massachusetts Institute of Technology.

F. A. Vanderlip, Esq., New York.

T. Morris Carnegie, Esq., New York.

R. A. Franks, Esq., Hoboken, N. J.

The trustees will take steps at once to organize a corporation. The first meeting of the board has been called for November 15.

SCIENTIFIC NOTES AND NEWS.

At the meeting of the Geographical Society of Philadelphia on May 3, the Elisha Kent Kane medal was awarded to Professor William B. Scott, of Princeton University.

The French government has conferred the rank of Officier d'Academie on Professor Angelo Heilprin, of Philadelphia, for his work in geography.

Dr. J. H. van't Hoff, professor of chemistry at the University of Berlin, has been elected a corresponding member of the Paris Academy of Sciences.

Professor Henry M. Howe, professor of metallurgy at Columbia University, has been elected corresponding member of the French Society for Encouragement of National Industry.

The Lavoisier medal of the French Society for the Encouragement of National Industry has been awarded to M. Héroult for his work on electro-metallurgy.

Dr. Ralph H. Curtiss, Carnegie assistant at the Lick Observatory, has been appointed assistant astronomer at the Allegheny Observatory, and will assume his new duties on about June 1.

Professor S. I. Bailey, who is in charge of the Peruvian station of the Harvard College Observatory, has returned to Cambridge, where he will remain for the present. He is planning to observe the August total eclipse of the sun in Spain.

Dr. Friedrich Kohlrausch, president of the 'Reichsanstalt,' retired on April 1.

Dr. H. F. L. Matthiessen, professor of physics at Rostock, having reached the age of seventy-five years, has been excused from holding further lectures.

Secretary William H. Taft will this year deliver the commencement address at Miami University.

Professor Jeremiah W. Jenks, of Cornell University, lectured before the Philadelphia Geographical Society on May 3, his subject being 'Life in the Interior of China,'

The first Adamson Lecture at Manchester University will be delivered by Professor Ward, of Cambridge, on June 2.

Torreya states that the American delegates, elected and, according to the rules of the International Botanical Congress, which meets at Vienna from June 11 to 18, entitled to vote in the deliberations upon the nomenclature question, are, so far as it has learned, the following: Members of the International Nomenclature Commission, N. L. Britton, E. L. Greene, B. L. Robinson, J. D. Smith; delegates from Section G, American Association for the Advancement of Science, C. R. Barnes, H. C. Cowles, C. L. Shear; from the Botanical Society of America, J. C. Arthur; from the Society for Plant Morphology and Physiology, W. G. Farlow; from U. S. Department of Agriculture, A. F. Woods; from the Torrey Botanical Club, N. L. Britton, L. M. Underwood; from the New York Academy of Sciences, L. M. Underwood; from the New York Botanical Garden, J. H. Barnhart; the American Academy of Arts and Sciences, the New England Botanical Club, the Boston Society of Natural History and the Vermont Botanical Club will be represented by B. L. Robinson.

Dr. Henry H. Goodell, president of the Massachusetts Agricultural College, died on April 23, at the age of sixty-six years.

We regret also to record the deaths of Professor Bruno Kerl, formerly professor of metallurgy in the Berlin Academy of Mines, at the age of eighty years, and of Dr. Leopold Maggi, professor of comparative anatomy at Pavia, who died on March 1.

There will be a civil service examination on May 17 to fill the position of bacteriological chemist in the Bureau of Chemistry, Department of Agriculture, at a salary of $2,000 a year. The position is open to those who have the degree of doctor of philosophy or who have an equivalent training.

The Cardiff Corporation has offered a site, worth £20,000, for the erection of a national museum for Wales, and has voted £2,000 for the maintenance of the museum and £1,000 a year towards the expenses of a library. The Mackintosh of Mackintosh has promised £2,000 towards the museum and library, provided Cardiff is selected as the locality. Mr. John Cory has also promised £2,000 on like terms.

The new sixty-inch reflecting telescope made in England in 1888 by the late A. A. Common and purchased this year by Harvard University, is being set up at the astronomical observatory. A two-story building, fifteen by twenty-seven feet, has been erected to inclose it.

We learn from *The Observatory* that Starfield, Crowborough Beacon, the house and observatory of the late Dr. Roberts, was put up to auction on March 17, but was not sold. The highest bid was £5,000, which was evidently below the reserve.

The International Bureau of Labor at Basel offers the following prizes for the best treatises on the following subjects: Prevention of danger in exploiting and preparing lead ores, $1,200; obviating danger from working the metal in lead works, $2,400; two best treatises on prevention of danger in the chemical use of lead in lead works, accumulator factories, etc., $600 and $350; nine prizes, ranging from $178 to $357, on obviating or removing the danger from lead poisoning in the trades where lead is used, such as painting, type casting, printing, etc.

It is announced that the prize founded in honor of the celebrated Geneva family of botanists, De Candolle, is now offered by the physics and natural history society, of Geneva, Switzerland. The subject will always be a description of a species or family of plants. Members of the society are not permitted to compete, and limitations as to nationality are not made. The essays may be written in Latin, German, French, English or Italian, and must be transmitted to the president of the society before January 16, 1906.

The second annual field symposium of botanists will be held during the week beginning July 3, 1905, at Ohio Pyle, a point on the Baltimore and Ohio Railroad in Fayette County, southwestern Pennsylvania, where arrangements have been made for the accommodation of the party. Information concerning details of the trip and the proposed program may be obtained from either Mr. Joseph Crawford, 2824 Franklin Avenue, Philadelphia, representing the Philadelphia Botanical Club, from Dr. J. A. Shafer, New York Botanical Garden, Bronx Park, New York City, representing the Torrey Botanical Club, or from Dr. J. N. Rose, U. S. National Museum, Washington, D. C., representing the Washington Botanical Club. The pleasant and profitable experiences gained by those who attended the first of these meetings, held at McCall's Ferry, Pennsylvania, in July of 1904, give reason to believe that there will be a large attendance at Ohio Pyle. A detailed report of the proceedings at McCall's Ferry will be found in the February issue of the *Plant World.*

A conference of scientific scholars was held at Colorado College, Colorado Springs, on April 28 and 29, leading universities and colleges sending representatives. A number of valuable papers upon subjects bearing on the scientific problems of the Rocky Mountain country were promised.

The annual conference of the British Child-Study Association will be held at Derby on May 11–13, under the presidency of Professor Muirhead, of Birmingham University.

The Boston Scientific Society celebrated its twenty-ninth anniversary at a dinner on April 25. Dr. H. Helm Clayton, of the Blue Hill Observatory, acted as toastmaster. Speeches were made by Professor A. E. Dolbear, of Tufts College, Professor George H. Barton, of the Teachers School of Science, Mr. John Ritchie, Jr., and others.

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., from June 19 to 23.

The United States consul at Frankfort reports that Professor Fluegge, president of the hygienic institute at Breslau, has sent the following circular to the owners and managers of dwellings in one of the districts of that city: "The common council has resolved to fight in a systematic manner the mosquito plague, which prevails every year, and the plan for the purpose has been worked out at this institute. It is necessary in the first place to destroy, before warm weather sets in, the mosquitoes which pass the winter in the cellars and basements of houses. These cellar and basement mosquitoes will be destroyed by municipal experts without inconvenience to the people and without injury to property. In order to make it possible to carry out the plan successfully we respectfully request the admittance of the disinfectors to the cellars of houses and permission for them to take the steps necessary to kill the mosquitoes. The disinfectors will have identification cards." According to the *Silesian Gazette,* the plan for fighting the mosquito plague is to be worked out in two directions. The hibernating mosquitoes, which are almost always found in the cellars of houses adjoining unoccupied territory, parks, gardens, etc., must be killed. These are found in somewhat damp cellars, facing north, and are recognizable with difficulty by those not experts, but cover the ceilings by thousands. In the spring they leave and lay their eggs in water, the larvæ producing mosquitoes within three to four weeks. A supplemental effort will be made to destroy the larvæ, which are found principally in stagnant, shallow pools. These must be either filled in or treated with malachite green or other larvæ-destroying substances. For the present this process will only be employed in that part of the city which suffers most from the mosquito plague. If it proves successful it will be extended next year over the whole city. Fighting mosquitoes will be carried on in a systematic manner on a scientific basis. Summer resorts and watering places, especially, should imitate the example set by Breslau.

We learn from *The Athenæum* that Dr. Theodor Koch, who for the last two years has been traveling in the interior of Brazil, sends a very interesting account of his travels. He followed the course of the Rio Uaupès beyond the last rapids, and spent a considerable time with the Kobéua Indians, whose religious mask dances are so curious. He made a thorough study of their language, and in their company visited the Rio Cuduiary. The whole district watered by these rivers is of great interest, as it is inhabited by a number of tribes who speak distinct dialects and retain all their ancient habits and customs, as the nature of the river renders their dwelling-place almost inaccessible. Dr. Koch has been successful in obtaining photographs, and has a fine collection of weapons, masks, costumes and domestic utensils.

According to the *British Medical Journal* in 1861 the total number of medical practitioners in Italy was 18,947, the proportion to population being 8.8 per 10,000. In 1881 it was 18,950, or 6.6 per 10,000. In 1901 it was 22,168, or 6.8 per 10,000. The distribution of practitioners is somewhat unequal, the proportion being higher in the south (7.7 per 10,000) than in the north (6.1 per 10,000). In the province of Udine the proportion is lower than anywhere else in Italy, there being only one practitioner to 2,831 inhabitants; in that of Naples it is highest, there being two doctors to 732 inhabitants.

UNIVERSITY AND EDUCATIONAL NEWS.

Dr. Brown Ayres on April 25 was inaugurated as president of the University of Tennessee. Senator James B. Frazier presided. The welcome to Dr. Ayres for the colleges of the east was delivered by Dr. J. S. Ames, professor of physics at the Johns Hopkins University; on behalf of the colleges of the west, by President George E. McLean, of the University of Iowa, and on behalf of the southern colleges, by Chancellor R. B. Fulton, of the University of Mississippi. Following Dr. Ayres's inaugural address Dr. Charles Dabney, president of the University of Cincinnati, who was the immediate predecessor of Dr. Ayres at Tennessee, delivered an address. Dr. Ayres came to the University of Tennessee from Tulane University, where he was professor of physics. At the inaugural exercises a gift was announced from Mr. Andrew Carnegie of $40,000 for a library building, conditioned upon the securing an equal amount as an endowment; and a gift of $7,600 from Mr. John L. Rhea, the income to be used in the interests of the engineering departments.

After a long contest in the courts the will of Henry C. Peabody, inventor of the rifle bearing his name, has been affirmed. This was partly the result of a compromise, by which an additional $20,000 goes to the heirs. About $350,000 will be used for the establishment of an industrial school for girls at Norwood, Mass.

The legislature of Tennessee, in passing a bill appropriating $25,000 a year for ten years for the Peabody Normal College, at Nashville, has assured the reception by that institution of $1,000,000 from the division of the Peabody Fund.

President Schurman, of Cornell University, has received $1,000 from Mr. and Mrs. Gerrit S. Miller, of Peterboro, N. Y., for the foundation of a free book fund in memory of William C. Seidell, who worked his way through the university and graduated in 1904.

University College, Sheffield, is to be given a charter as the University of Sheffield. The city will contribute about $40,000 annually to its support. The present college buildings, which are not united on a single site, are to be vacated shortly for handsome new buildings on a site adjoining one of the public parks of Sheffield, now within a few months of completion.

A summer school will be held at the University of Colorado, Boulder, from June 17 to July 26. Courses in science are as follows: chemistry, physics, geology, psychology and botany. The work will be given by the regular professors of the university.

Professor R. B. C. Johnson (philosophy) and C. H. McIlwain (history) have resigned from Miami University to accept preceptorships at Princeton University.

At the recent annual meeting of the regents of the University of Nebraska Dr. F. D. Heald, adjunct professor of plant physiology, was elected botanist of the Agricultural Experiment Station, and associate professor of botany in the University School of Agriculture. Appropriations were made for equipping his laboratories in the new Agricultural Hall on the station farm. At the same meeting Dr. F. E. Clements, assistant professor of botany, was promoted to be associate professor of plant physiology.

Dr. Alfred Hettner, associate professor of geography at Heidelberg, has declined a call to a professorship at Breslau.

Dr. Paul Grube has resigned the chair of physics in the University of Giessen.

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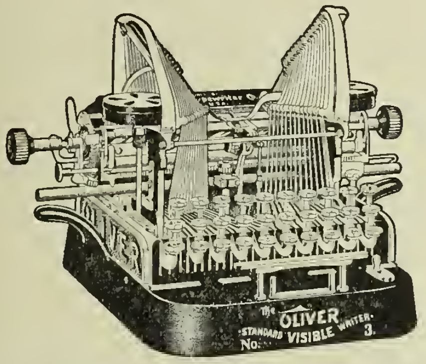

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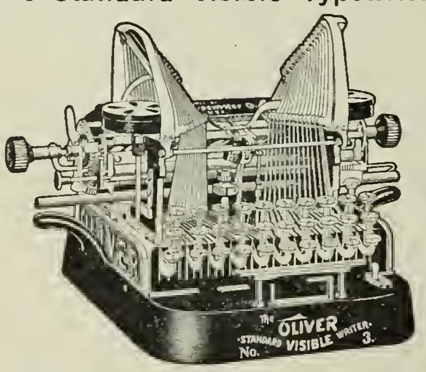

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FRIDAY, MAY 12, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION D, MECHANICAL SCIENCE AND ENGINEERING.

THE meetings were held in the engineering building of the University of Pennsylvania. The following officers were elected to serve during the meeting:

Councilor—F. W. McNair, president Michigan College of Mines, Houghton, Mich.

Member of the General Committee—H. S. Jacoby, professor of bridge engineering, Cornell University, Ithaca, N. Y.

Member of the Sectional Committee, 1905 to 1910—A. M. Greene, Jr., professor of mechanical engineering, University of Missouri, Columbia, Mo.

The secretary of the section was elected press secretary; vice-president and chairman of the section D. S. Jacobus, professor of experimental engineering, Stevens Institute, Hoboken, N. J., was forced to be absent, owing to illness in his family. The sectional committee appointed Calvin M. Woodward, ex-vice-president of the section, to act as chairman of the section for the meeting.

The program had been arranged so that papers pertaining to civil engineering, mechanical engineering, metallurgical engineering and general engineering, and to engineering education, should be read at separate sessions. The program of Wednesday morning, December 28, was devoted to civil engineering. The first paper on the program was by C. G. Elliott, expert in irrigation and drainage investigations of the Department of Agriculture, Washington, D. C., and was on 'Irrigation and Drainage Investigations of the Department of Agriculture.' He showed that while chemical analysis may show that two soils are equally rich in plant food, yet on account of unfavorable water conditions, one of them may be quite unproductive, and the different portions of even the same field may vary in their production on account of differences in the water content of the soil. The supply of water and the control or regulation of its quantity in soils of different classes under varying climatic conditions for the production of crops of a first-class character present an important field which now occupies the attention of the irrigation and drainage investigations. The objects of this work are to ascertain the best methods and provoke their use in applying water to soils where it is deficient, conserving and regulating its quantity, removing surplus from saturated soils and reclaiming and protecting lands from overflow, all of which invokes a variety of engineering practise. The soil water necessary for the growth of plants is held about soil drains in films and is removed from the soil by capillarity, plant absorption and surface evaporation only. Irrigation must supply this amount when deficient, and any surplus must be removed by drainage. The water-holding capacity of different soils is an important subject for investigation. The part of the engineer is to provide means for supplying, regulating and controlling the soil water to meet the needs of the various kinds of soils encountered and plants grown therein, and includes a study of the movements of water, both by capillarity and by gravity.

Henry S. Jacoby, professor of bridge engineering, Cornell University, Ithaca, N. Y., presented 'Some Notes on Reinforced Concrete Arches,' giving the results of his study and investigations during the past year and supplementing his previous papers.

E. J. McCaustland, assistant professor in civil engineering, Cornell University, Ithaca, N. Y., next presented a paper on 'Tests of Reinforced Concrete Beams,' in which he presented the data and conclusions obtained from the tests to failure of twenty-three beams of concrete, reinforced by plain and various forms of patented bars of steel. They were 6 by 8 inches in size and 6 feet long. Plain square steel rods were used, varying in sizes from $\frac{3}{8}$ to $\frac{3}{4}$ inch and placed either $1\frac{1}{4}$ or 2 inches from the lower face of the beam. The beams were made of a very lean concrete (1 cement, 2.5 sand and 9 broken limestone), so that in all cases the steel reinforcing bars developed full strength of the concrete before reaching the elastic limit. Deflections were measured, and also the extensions of the lower fibers. A careful watch was kept to determine the appearance of fine cracks. The loads were released after each reading so as to measure the set. Tests of the beams with plain square bars showed poor adhesion and the early development of fine cracks, so that the smallest percentage of reinforcement seemed sufficient. The beams having reinforcement $1\frac{1}{4}$ inches from the lower face showed greatest strength. In the second series sets of beams were laid up with reinforcements of Ransome bars, Johnson corrugated bars, Kahn bars, corrugated bars with iron stirrups, Thatcher bars, and two beams with plain bars for comparison. The ratio of reinforcement was made about 0.58 per cent. and the center of the steel bars was placed $1\frac{1}{2}$ inches from the lower face of the beams. The extensibility of the reinforced concrete in these tests was one in 1,621, while that of the plain concrete was one in 11,000. The results show the superiority of the corrugated bars under ordinary conditions. They also draw sharp attention to an interior weakness in a reinforcement having diagonal wings rigidly attached. The tests show the folly of attempting to reinforce a concrete which will not of itself develop a fair degree of strength, and they throw very serious doubts upon the wisdom of using certain types of diagonal reinforcements in beams. The paper will probably be published in the *Engineering Record.*

Owing to the absence of Mr. Richard L. Humphrey, consulting engineer, of Philadelphia, his paper on 'Some Notes on the Manufacture and Testing of Cement' was read only by title.

In a paper on 'The Menace to the Entrance of New York Harbor,' by Lewis M. Haupt, consulting engineer, Philadelphia, after reviewing the different projects which have been carried on by the general government for the improvement of the channels leading into the lower bay, the author showed by means of charts that in the past century the inlet to Jamaica Bay has moved seven miles to the west, and also that the spit at Sandy Hook has advanced about a mile, and is now moving into the bay, depositing half a million yards of sand every year. It was held that these encroachments upon the entrance to New York harbor formed a menace which could no longer be overlooked. The author found a remedy in a single reaction training wall which would concentrate the ebb of the currents and prevent the continued deposit of drift which threatens to convert Coney Island and Manhattan Beach into lagoons. The estimated cost of this would be but one-half of the present contract for dredging the channel, which it is stated can not be maintained, as it fills up very rapidly. The paper was subsequently read before Section E; and extracts of it were published in the New York daily papers and caused much discussion in both engineering and commercial circles.

At the conclusion of this paper, Section D joined the meeting of Section I to listen to a paper and discussion on 'Specialization in Manufacturing' by Alexander E. Outerbridge, Jr., metallurgist of William Sellers & Company, Incorporated, of Philadelphia. The paper gave data from actual experience, showing the enormous economies, as well as limitations, of the modern methods of concentrated effort and capital in a single production, as compared with older methods in general practise. The paper will be found in full in the January issue of the *Annals of the American Academy of Political and Social Science.*

On Wednesday afternoon after luncheon the members of the section, in charge of competent guides, visited the new electric power station of the Philadelphia Electric Company. This station presented a notable illustration of the many uses of concrete, of which the most novel was probably the installation of the high tension wires and fuses in vertical cases made of monolithic concrete construction.

Later the members visited the high pressure fire service plant of the city of Philadelphia. This plant is notable in that the large triplex power pumps are operated by gas-engines supplied with artificial gas from the city mains. No standby losses are incurred, full pressure is available in two minutes from the time the fire alarm is sounded, which is much sooner than the company can get to the hydrant nearest to the fire. The quantity of water is much larger than could be obtained by the normal number of fire engines, while ample provision in the way of valves has been made for the bursting of mains.

On Thursday morning, owing to the absence of the author, paper number seven, on 'Some Notes on Ventilating Problems,' by Charles B. Dudley, of the Pennsylvania Railroad Co., Altoona, Pa., was read by title only. It was followed by an interesting paper by C. J. Zintheo, professor of farm mechanics, Iowa State College, Ames, Ia., on 'American Machinery as a Factor in Agriculture':

"Farm machinery has made it possible to develop the vast agricultural resources of the country. During the first two hundred years after the Pilgrim Fathers settled on the American shore, the resources of the country failed to bring about any increase of importance in commerce or in the products of agriculture. As late as 1845, people did not raise enough wheat for their bread. With the advent of the steel plow, the self-binding harvester and the steam threshing machine, there was a marked change in the producing power of the American people. Our food supply increased from 4.33 bushels of wheat per person in 1845 to 5.50 bushels of wheat in 1859; to 7.45 bushels in 1869, and as high as ten bushels in 1889. During the same time the population on the farms had decreased to 80 per cent. in 1850 and 33 per cent. in 1900. The American farmers of to-day with one third the labor of the country produce enough food to support, not only themselves, but the other 67 per cent. that live in the cities, and exported farm products during the year 1904 to the value of the enormous sum of $960,000,000, according to the United States Secretary's report. This same report states that in 1830 it took over three hours' labor to raise one bushel of wheat; in 1896 it took ten minutes. In 1830 the labor in one bushel of wheat cost 17¾ cents; in 1896 it cost 3½ cents. In 1850 the labor represented in a bushel of corn was four and one half hours, while in 1894 it had been reduced to forty-one minutes. (This has been greatly reduced since then by the introduction of the more modern corn harvesting machines.) In 1860 it is estimated that the labor in one ton of hay in bales represented 35½ hours, while in 1894 this labor was reduced to 11½ hours, or from a cost of $3.00 in labor to $1.29 in labor. The report estimates that in the year 1899 the agricultural implements in the United States saved in human labor the sum of $681,471,827. This country is the greatest maker and user of agricultural implements in the world, and this is largely due to the fact that this country is the most prosperous agricultural country in the world. It has enabled the farmer to pay the high price for labor caused by the competition of our manufacture, and has taken away from farm life much of the drudgery and manual labor and made it in the best sense an intellectual pursuit. Improvements in machinery have brought about a steady decrease in the cost of production, notwithstanding the steady rise in wages. To give an idea of the vast sums of money invested in farm machinery, take, for instance, the following states: Iowa has $57,960,000 invested; New York, $56,006,000; Pennsylvania, $50,917,240; Illinois, $44,977,310; and Ohio, $36,354,450. The total value of implements on farms in this country is $761,261,000, an average of $133 per farm and 90 cents per acre of farm land. The American farmers buy annually $100,000,000 of farm implements. New designs of farm machinery are being constantly added, so that the farm machinery is surely the greatest factor in the development of American Agriculture."

In a paper on 'A Method of Determining the Moisture Existing in Steam at Atmospheric Pressure,' D. S. Jacobus, professor of experimental engineering, Stevens Institute of Technology, Hoboken, N. J., illustrated with blue prints and described the method which he had adopted for determining the dryness of steam. It consisted of mingling a known weight of superheated steam with a known weight of saturated steam at atmospheric pressure. The steam was still superheated after mingling and its temperature was measured. Careful measurements were made to determine the radiation of the apparatus. From data thus obtained the amount of moisture in the saturated steam was determined. This method is similar to that employed by Mr. George H. Barrus in one of the older forms of his calorimeters. The particular problem to be investigated was how much moisture would be contained in steam at atmospheric pressure after it had passed through two separators of a certain form. The tests showed that the steam at atmospheric pressure leaving the separators contained about one tenth of one per cent. of moisture, a result which was within the probable error of the instrument, for which reason it was fair to conclude that the steam was dry.

The paper will be published in the *Engineering Review.*

G. W. Bissell, professor of mechanical engineering, Iowa State College, Ames, Ia., next presented a paper on 'Hot Blast Heating and Ventilating,' giving results of experiments on the heating and ventilation of the new engineering building of Iowa State College. This building is equipped with Sturtevant hot blast apparatus, the Paul system of vacuum steam heating, and the Powers system of temperature regulation. The total steam condensation was measured hourly, and continuous records were kept for two months. Forty-three separate tests were made at steam pressures, varying from 5 to 25 pounds and with air pressures varying from 0.6 to 1.5 inches. The paper gave a series of tests showing the coefficients of condensation with one or more sections of coils in use, and at different steam pressures, and with different quantities of air being forced over the coils. The paper was published in the *Engineering Review.*

In a case where a man was killed by the bursting of an elbow on a steam main near which he was working, the question arose as to the number of pieces into which such would be broken if it were struck with a hammer when under steam pressure. D. S. Jacobus, professor of experimental engineering, Stevens Institute of Technology, Hoboken, N. J., presented the results of tests which he had made on fittings of the same size and weight as the one which caused the accident and on some similar fittings. The former was an extra heavy elbow for a three-inch standard pipe. The smaller fittings which were tested were of two-inch standard size and of the ordinary weight. In the tests, the elbows were broken by hitting them with a hammer swung by hand when they were subjected to pressures of 80 and 100 pounds per square inch. The hammer, together with its handle, weighed four pounds. The fittings were struck on the outside directly over each of the screw threads at points directly opposite the neck and in the plane passing through the pipe centers. The extra heavy three-inch elbows broke in two nearly symmetrical halves, the plane of breakage being that passing through the pipe centers. The two-inch fittings of ordinary weight broke in two to four or more irregular pieces. The paper was published in the *Engineering Record.*

L. E. Löewenstein, of the Department of Mechanical Engineering, Lehigh University, South Bethlehem, Pa., next presented a paper on 'Some of the Scientific Features and Development of the Steam Turbine.' As the author is the American translator of Professor Stadola's German work on this subject, the paper was of much interest to the audience which heard it.

In a third paper by Professor Jacobus, the angular displacement of the revolving fields of two alternating current electric generators when connected in parallel was determined by actual measurements and compared with the computed amounts. The results were found to agree very closely with each other. The generators on which the tests were made were of 1,500 kw. capacity and were located at the Manchester Street Station of the Rhode Island Co., Providence, R. I. Large counterweights had been placed on the engines in order to reduce the amount that they shook the building. It was shown theoretically that when the generators were coupled together with the counterweights opposed, or at 180° from each other, the angular displacement was about twice what it would have been without the counterweights. The maximum displacement due to counterweight action and to irregularity in the effort exerted on the crank shaft was found by theory to be 3.2 pole degrees and by observation from 3 to 4 pole degrees. The amount of angular displacement was observed to be the same, irrespective of the position of the counterweights, but when the counterweights were opposed the displacements occurred every stroke, or about 94 times per minute, whereas, when the counterweights were together, or nearly so, the displacements occurred at less frequent intervals, or about 30 to 40 times per minute. As the total displacement of the two fields from their true positions, as observed, was about the same irrespective of the relative positions of the two counterweights, it follows that this displacement was produced as much through governor action as through any variation in the turning effort during a single revolution.

On Thursday afternoon, under the able guidance of Professor Marburg, the members of the section were guests at luncheon of the contractor for the Belmont Filtration Plant. After enjoying the social features of the afternoon, the members of the party were conducted through the gate house, filtering galleries, and had the details of the operation explained to them in much detail by Mr. John W. Hill, chief engineer of the bureau of filtration, and his son. The observations of the afternoon made the succeeding illustrations of the evening much more real and valuable to those who had the privilege of hearing both the afternoon demonstrations and the evening lecture.

The Thursday evening session of Section D was devoted to three extremely valuable papers by notable engineers of the city of Philadelphia, on subjects which are of much interest, both to engineers and citizens of Philadelphia and to engineers and scientists at large. They were very fully illustrated by lantern slides. The first was by J. W. Hill, chief engineer of the Bureau of Filtration of the Department of Public Works of Philadelphia, and was on 'The Philadelphia Filtration System.'

The second paper of the evening was by Wm. S. Twining, chief engineer of the Philadelphia Rapid Transit Co., and described and illustrated 'The Subway and Elevated Railroad of the Philadelphia Rapid Transit Company.'

The third paper was by George H. Webster, chief engineer, bureau of surveys of the board of public works of Philadelphia, and was on 'Modern Engineering in the City of Philadelphia, under the Direction of the Bureau of Surveys.'

These papers were both most entertaining and instructive, and showed the great advances which have been made in the practical applications of engineering science in the municipal affairs of the city of Philadephia in providing for the citizens a healthful water supply, rapid and convenient methods of transportation, and up-to-date and modern methods of keeping records and performing the routine work of the office of city engineer in a large municipality.

The first paper on the program of Friday morning, December 30, was by Arthur H. Blanchard, assistant professor of civil engineering, Brown University, Providence, R. I., and was on 'The Development of the State Highway System of Rhode Island':

"The first tangible step towards the establishment of a state system of continuous highways in Rhode Island was the passage of an 'act to provide for the construction, improvement and maintenance of state roads' by the General Assembly in 1902. The salient features of the 1902 act are as follows: the construction and maintenance of the state highway system is vested in a board, consisting of five members, who serve without remuneration: the chief engineer is appointed by the board; the entire expense of construction and maintenance of standard roads is borne by the state, resulting in a maximum benefit to the state as a whole and to the urban as well as the rural communities (the fifteen trunk highways comprising the state system of continuous roads have a total mileage of 249 miles, 18.89 of which was contracted for by the state in 1903) ; an annual appropriation of $5,000 for general office expenses is included in the act: annual construction appropriations are based upon the annual reports of the board ($100,000 in 1903 and $100,000 in 1904) ; cost of extra width, in excess of fourteen feet, is to be borne by the towns concerned. The standard macadam road consists of 14 feet of 6-inch macadam, built in two courses of broken stone, with dust used as a top dressing only, the surface being in form, the two intersecting planes having a tranverse slope of three fourths of an inch to the foot. By the knowledge obtained from road metal tests made at Washington, together with information gained from observations on how the material actually wears and binds in practice, the board hopes to reach satisfactory conclusions with reference to the rocks that may be used for road building purposes in Rhode Island. The recognition of the injurious effects of narrow tires upon macadam roads resulted in the passage of an act in 1902 to prohibit the use of narrow tires after April, 1905. It is believed that a rigid enforcement of this law will materially reduce the cost of maintenance of the state roads."

The next two papers on the morning's program were on 'Lines of Progress in Aeronautics,' and were intended to supplement the series of papers on this subject which were presented at the St. Louis meeting of the association. Calvin M. Woodward, dean of the School of Engineering and Architecture of Washington University, St. Louis, Mo., described the efforts which had been made and stated some of the reasons why they had not met with greater success at the Louisiana Purchase Exposition during the past year. Being a member of the committee of the World's Fair on the subject of aeronautics, he was able to speak with positive knowledge.

The second paper was by Mr. K. Dientsbach, of New York, who is the American correspondent of *Illustrierte Aeronautische Mitteillungen.* He reviewed the recent progress made in aeronautical science by Maxim, Langley, Zahm and the Wright Brothers.

In the absence of the author, the paper by David Todd, director of Amherst College Observatory, on 'A Twelve-ton Observatory Dome of Thirty-five Feet Diameter,' was read only by title.

Clarence A. Waldo, professor of mathematics at Purdue University, Lafayette, Ind., presented samples of 'A New Engineering Product, and Some of Its Problems.' The product consisted of metallic materials formed into hollow shapes, such as flasks, floats, spheres, bottles and the like. It was much to be regretted that the exact method of manufacture was not described, and the 'problems' which had been met were only stated and their solution not given.

A. J. Wood, professor of experimental

engineering, Pennsylvania State College, State College, Pa., next read a paper giving the results of his experiments on 'Tests of Cold Drawn Steel Elevator Guides.' He stated that many engineers were of the opinion that the cold rolling improved the tensile strength of steel more than did cold drawing. The paper called attention to tests recently made by the author showing the comparative strengths in transverse loading of hot-rolled and planed T-shaped elevator guide-bars supported on 24-inch centers, as compared with cold-drawn bars made from hot-rolled bars. The open hearth steel which was used contained from 0.12 to 0.15 per cent. of carbon. The hot-rolled bars weighed 14⅝ pounds per foot, and after rolling 14 pounds per foot. The autographic stress-strain diagrams of the bar show that the actual elastic limit was increased from 13,900 pounds with the hot-rolled bars to 35,000 pounds with the cold-drawn bars, and that the yield point was increased from 17,500 to 38,500 by the process of cold-drawing; that the cold-drawn steel not only deflected less under a given load, but that it suffered less permanent set. The paper will be published by the *American Machinist*.

The last paper of the morning was by C. M. Woodward and was on 'The Track Pressure Resulting from an Eccentric Weight.' The paper elicited considerable discussion from the mathematical engineers who were present. It will be published by the St. Louis Academy of Science.

The session of Friday afternoon was devoted to engineering education. The vice-presidential address of the retiring vice-president, Calvin M. Woodward, dean of the School of Engineering and Architecture, Washington University, St. Louis, Mo., on 'Recent Progress in Engineering Education,' was true to its subject, and as it has been presented in the pages of Science for January 6, 1905, nothing further need be said.

Edgar Marburg, professor of civil engineering, University of Pennsylvania, next described the new engineering building of the University of Pennsylvania. It is expected that it will cost $700,000, and with its new additional equipment will cost $800,000. It will be capable of providing for 500 engineering students in civil, mechanical and electrical engineering. One of the noteworthy features is that of a large number of small rooms each containing comfortably not over fifteen students. These are to be used for recitation rooms and quizzes. Larger assembly rooms for all the sections of the class are also provided, where one of the instructors can lecture to the class as a whole. This system of instruction and also the details of the building were discussed at considerable length by the educators present.

'Desired Requirements for Entrance to Engineering Colleges' was the subject of a paper by William Kent, dean of the College of Applied Science, Syracuse University, Syracuse, N. Y. He stated that the present requirements included English, history, mathematics, physics, science and modern languages, each of which cultivates a separate group of intellectual faculties. At Syracuse University a change has been made in the direction of broadening the entrance requirements so as to require six groups of study, and including free-hand drawing as one of the essential subjects. It is now proposed to make another change so as to require studies in seven groups, which, besides free-hand drawing, physics or chemistry, shall include one or more natural sciences. The following advantages are claimed for the proposed entrance requirements. First, the requirement of seven studies instead of eight makes it easier for high schools to give a thorough preparation. Second, it will decrease the number of conditions of entering students. Third, seven subjects selected from the seven groups, each studied with proper thoroughness, give a more liberal and broader education than eight subjects from five groups, including electives which may be selected from the same five groups. Fourth, they include drawing and natural science, without which no one can rightly be said to have a broad and liberal culture. Fifth, by making options in language and in physics and natural science, the requirements favor those high schools which are equipped to give some optional subjects better than others. Requiring either physics or chemistry, and not both, is a convenience to the college, so that either physics or chemistry can be given in the freshman year to those students who do not present one or the other.

The last paper scheduled for the afternoon had been read at a previous session of the section and was on 'The Value of Courses in Agricultural Engineering,' by Elwood Mead, chief of irrigation and drainage investigations, U. S. Department of Agriculture, Washington, D. C.:

"Agricultural engineers have hitherto had little opportunity for practising their profession in the United States, the large areas of cheap land and crude and wasteful methods of cultivation preventing any large expenditures on engineering works for the improvement or reclamation of agricultural areas.

"These conditions are now rapidly changing. The building of canals and dams to irrigate the arid lands of the west, the construction of dikes and drains, and the installation of pumps to remove the surplus water from our swamp and overflowed lands are two of a number of lines of work which are opening up broad fields of usefulness and power to specially trained young men. Our agricultural colleges are recognizing this and beginning to provide adequate courses of instruction. Within the past year the Iowa State College has completed a commodious building, with a complete equipment for instruction in this branch of engineering. Wisconsin is erecting a building; Illinois, Minnesota, Nebraska and Wyoming have courses in agricultural engineering; while Colorado and California make irrigation engineering one feature of their courses in civil engineering. Special training in the administration of canals and in the laws and customs governing the use of streams is required by the irrigation engineer. This is being provided by the agricultural colleges and by the reports of the irrigation and drainage investigations of the Office of Experiment Stations, U. S. Department of Agriculture.

"Drainage engineering is becoming an important factor in agricultural production. The reclamation of the swamp and overflowed lands along our sea and gulf coasts will add nearly 100,000,000 acres to the productive area. Tile underdrains are being made use of to protect hillside farms from erosion.

"Modern farm machinery includes motors run by steam, gasoline, electricity and wind. Where farmers do not understand their care and management, there is great waste and loss. Although this country is the greatest maker and user of farm machinery in the world, the agricultural schools of the United States are far behind those of Europe in the training given on this subject."

The last session of the section was held on Friday evening, and, like those which had preceded it, was provided with a very full program. The first paper of the evening was by John Birkinbine, consulting engineer, of Philadelphia, and discussed 'The Iron Ore Supply of the United States and Its Movement.' The author stated that the advances made in iron manufacture have been largely brought about by methods of transporting and handling 35,000,000 long tons of iron ore which form the product of the mines of the United States. So successfully has this transportation problem been solved to cheaply handle ores from the mines to cars and from cars through docks to vessels, again from vessels to stock piles or to cars, that a number of deposits of iron ore are lying dormant close to blast furnaces because cheap transportation delivered iron ore of superior quality to the furnaces at a lower cost than it is believed the local ores can be won and used. The excellent quality of the Lake Superior ores and their very low phosphorus and sulphur contents make these ores especially desirable. The ore from the Lake Superior region forms over three fourths of all the iron ore mined in the United States. A large portion of it is not touched by the hand of man from the time it leaves its bed in mother earth until it is charged into the throat of the blast furnace. Steam shovels, automatic chutes, drop bottom cars, mechanical handlers, bridge tramways, bins and skip cars take the place of manual labor and permit handling and transporting large quantities of iron ore at a marvelously low rate. By this means the American iron ores can be conveyed long distances from the mines to the point of consumption at an extremely low rate per ton.

The paper will be found on page 56 of the *Iron Trade Review*, March 16, 1905.

'Science in the Foundry' was the subject of a paper presented by Alexander E. Outerbridge, Jr., metallurgist of Wm. Sellers & Co., Incorporated, of Philadelphia, Pa. It was illustrated with lantern slides showing the interiors of foundries in several large industrial establishments, giving realistic views of immense molds and of castings made therein; of the modern 'overhead traveling cranes,' capable of raising fifty tons or more, and transporting these heavy castings and materials with safety and despatch over the heads of the molders and other workmen on the floor. Pictures showing the characteristic appearance of fractured bars of iron, and of castings of different kinds, ranging from tiny castings weighing a few ounces up to immense machinery castings weighing many tons, were thrown on the screen. Photographs of bars of cast iron which had been caused to 'grow' in cubical dimensions in a remarkable manner, while in the solid state; also photographs of a number of castings which had been increased in size by a novel treatment were shown—for which discovery the Franklin Institute recently awarded to the author the 'Elliot Cresson Gold Medal,' the highest in its power to bestow. Two bars of iron cast in one mold, and of precisely the same size, were presented for critical inspection, one bar remained exactly as cast, the companion bar had been caused to grow gradually in cubical dimensions until it is now 46 per cent. larger than the other, the weight remaining the same as before expansion. Both bars were 'machined' on one side to show the texture and metallic appearance; it was difficult to detect any change except the very apparent difference in size. This extraordinary change in bulk was produced by alternately heating and cooling the bar to a 'critical' temperature a number of times, in the manner which has been fully described in the 'Report of the Committee of Science and Arts of the Franklin Institute.' Important practical applications have already been found for this remarkable discovery. The speaker said that formerly there was no scientific method of supervision in foundry practise, and a chemist in a foundry would have been thought to be as much out of his proper sphere as the proverbial 'bull in a china shop'! That day has gone by, and the substitution of scientific system for empirical methods in progressive foundries has gradually grown from very small beginnings until it has now reached a recognized position of importance. This is true not only in regard to the metallurgical study of pig iron for castings, but also in methods of molding and other cognate branches of the founder's art. The recent great improvement in the design and construction of molding-machines has led to the gradual substitution of machine molding for hand labor in a large and rapidly expanding degree. The scientific examination of molding sand and other materials used in molding has led to important improvements and economies. In fact, the influence of this newly awakened scientific interest in foundry improvement is extending in all directions. The result is that the manufacturer of machinery is enabled to obtain castings from foundries conducted on modern methods which are far better adapted to the work for which they are designed than heretofore, and he is, therefore, enabled to guarantee quality and strength with an assurance which he could not formerly give. From these observations it may be inferred that, although the field for cast iron has been invaded to a great extent by cast steel, the producers of iron castings have been spurred on to improve their product, and thus to keep in line with the progress of the age, and to show that in spite of this competition the field is still open for their occupation.

One of the most interesting papers of the Philadelphia meeting was on 'Recent Advances in the Mechanical Science Involved in the Coinage of Money,' by Edwin S. Church, superintendent of machinery, United States Mint, Philadelphia. It was illustrated by lantern slides and described in much detail the process of manufacturing money from the power plant with its large engines, through the various processes required in the coinage of money by rolling, stamping, punching and milling, and the great pressures which are necessary to effect the results. Mr. Church made the interesting statement that it was impossible for the new United States Mint at Philadelphia, with all its increased facilities, to supply the demand for copper cents during the two or three weeks immediately preceding the Christmas holidays, showing to what a large extent Christmas is the children's festival, and how largely it enters into the business of our country.

The sectional committee of Section D desires to express its cordial appreciation of the kindly attention and services rendered it by Professor Edgar Marburg and Professor H. W. Spangler, of the University of Pennsylvania, and to the engineers of Philadelphia who so kindly took part, either on the program or in the excursions, or permitted us to visit their works.

It is to be regretted that a larger number of the members of the association were not in attendance, and especially when it is remembered that there has been a large increase in the membership of both the association and the section within the past few years. Papers alone, even by eminent men, do not make a successful meeting. They may form an attractive program, but one of their chief objects is to elicit discussion, without which any program, no matter how good, is likely to fall flat. While there was some discussion over some of the papers presented at the Philadelphia meeting before Section D, neither the attendance of members nor the discussions were as plentiful as was desired. The sectional committee may procure and present a suitable program, but unless the members attend the sessions and take part in the discussions, its work will be largely in vain. It is to be hoped that the members of the association will make a special effort, even if it includes some sacrifice, to attend the meeting at New Orleans next December.

Wm. T. Magruder,
Secretary.

THE FISHERIES LABORATORY AT BEAUFORT, SIXTH SEASON.

The Fisheries Laboratory at Beaufort, N. C., was open to investigators for its sixth season from June 10 to September 30, 1904. A few days prior to this time two of the laboratory tables were occupied and a few investigators continued their work after the date of closing, but in these cases the facilities of the laboratory only were supplied, the dining hall, living rooms and electric-light department not being open outside the regular season.

A furnished living room was assigned to each investigator or assistant who desired to live at the laboratory, for the use of which a fee of twenty-five cents was charged to cover the expense of laboratory laundry. Table board was provided at the cost of the materials used and the wages of the waiters, the laboratory, as hitherto, supplying the cook, an assistant, and the kitchen and dining room equipment. The price of board was fixed at $5.50 per week, but, as indicated above, this department was run as a mess and at the end of the season a rebate was paid to each member, which reduced the actual cost of board to about $4.80 per week.

The entire laboratory was lighted with electricity from dusk until eleven o'clock P.M. and the work tables and aquaria in the laboratory and aquarium hall were furnished with a continuous supply of running water, both salt and fresh. The occupant of each table was supplied with a limited amount of glassware and the reagents in common use. The equipment for collecting and general field work, which was available to all, consisted of a steam launch, a 33-foot sharpy, nine rowboats, a pound net, a fyke net, seines, scrape nets, tow nets, dredges, a trawl and implements for digging. With this equipment the entire harbor and the adjacent sounds were within easy reach and, during calm weather, trips were made outside the inlet, where dredgings and towings were frequently made. This equipment was in the charge of Mr. Charles Hatsel, one of the permanent employees of the laboratory. He is an excellent collector and is thoroughly familiar with the animals of the region and the methods by which they may best be collected. Those carrying on scientific work consulted with him concerning the material needed and he either directed how, when and where the collecting should be done or, if necessary, collected and brought the material to the tables.

The staff consisted of a director, custodian, two laborers, five special assistants, thirteen temporary assistants, an engineer and two firemen in the power house, a crew of three on the steam launch *Petrel*, a janitor for the laboratory and living rooms and a cook and an assistant in the kitchen. In addition to these, eight investigators, representing various institutions, occupied tables in the laboratory and carried on work in various fields of inquiry. The average length of the stay of each was seven weeks.

The temporary assistants were assigned for duty as follows: two were detailed to assist Professors H. V. Wilson and George Lefevre with their work; two were given work in the office; four had the care of the laboratory and premises; three, assisted by one of the special assistants, did the seining and fishing with the pound and fyke nets for the laboratory and helped with the work on the fishes when they were brought to the laboratory; one assistant kept a record of the densities, temperatures and the general climatic conditions as observed by him during the season. Several of these men, when not busy with their regular duties, helped with cataloguing the books of the library.

The additions which were made to the equipment of the laboratory during the summer consisted in a pound net, a fyke net and sixteen rectangular glass aquaria of graded sizes. Two large concrete aquaria also were constructed and fitted with heating apparatus to be used for observations on the effect temperature may have on the structure and development of a species.

Early in the season letters were sent to more than a hundred American zoologists asking them to send their publications, past and future, to the library. In response to these letters several hundred reprints of scientific papers were received, which, added to the publications of the Bureau of Fisheries and the National Museum already on hand, make a valuable part of the equipment.

ECONOMIC AND SCIENTIFIC WORK CARRIED ON BY THE LABORATORY.

The several lines of fishery experiment work which have been in operation in connection with the laboratory for several years were continued and enlarged during this season.* Several weeks during the summer were spent by Mr. R. E. Coker (custodian of the laboratory) in Pamlico Sound in connection with the experiments in oyster culture. The progress of this work is best seen from the report by Caswell Grave, now in press, and from the paper by Mr. R. E. Coker on 'Private Oyster-planting in North Carolina,' also in press. Many new experimental oyster beds were made and will be the subject of further observation.

The growing importance of the clam (*Venus mercenaria*) with the development of the canning and bedding industries, has suggested an inquiry into the habits, growth and propagation of this form. Accordingly, during the preceding spring experiments were begun under the direction of Mr. Coker and these were continued in operation and extended. Arrangements have been made for their continuance during the remainder of the fiscal year.

Mr. Coker continued his study of diversity in the scutes of chelonia, obtaining some material for the further study of correlation in the scutes and bony plates. The forms studied were chiefly the diamond-back terrapin (*Malaclemmys centrata* Latr. and *Thallasoechelys casetta*), but observations were made on a few other species.

The work which is more definitely identified with the summer sessions of the laboratory consists in extended observations on the natural history of the various species representing certain groups of animals and plants. Notes on the following points concerning each species are collected and catalogued: Relative numbers, habitat, food, feeding habits, breeding time, breeding habits, character of eggs, young, migrations, local varieties, etc. Specimens of each species are collected and preserved and placed in the laboratory collection. As a final result of this work it is intended that reports on each group shall be prepared for publication, with descriptions of each species, and illustrations embodying the local observations which have been made. The special assistants who carry on this work are teachers of biology or graduate students in various institutions who have either specialized in or are especially interested at present in the groups in hand. The groups which were studied this season were the sponges, marine algæ, crustacea, actinozoa, fishes and echinoderms.

The work on the Beaufort sponges was begun this season by H. V. Wilson, professor of biology in the University of North Carolina. In addition to a study of the structural characters and natural history of each species he began a series of experiments on the effect of altered temperature and density on the habits of growth, struc-

* The North Carolina Geological Survey cooperates with the Bureau of Fisheries in these investigations.

ture and reproduction of certain forms. Special facilities were afforded for this work and an assistant was detailed to help with it. The observations will probably extend over a number of years. Professor Wilson will report progress from time to time.

Mr. W. D. Hoyt, instructor in biology in the University of Georgia, continued the work on the marine algæ begun by him last season. The intermediate position of Beaufort Harbor between the northern and southern regions, where extended observations have been made on the marine algæ, makes the study of the forms occurring in the Beaufort region especially interesting and important. That it is richer in algæ than has been supposed has been shown by the work already done. During the season twenty-five species were added to the list, which now numbers sixty-nine. All the species are represented by specimens in the laboratory collection. Of the forty species which are properly identified, two are Schizophyceæ, four are Chlorophyceæ, five are Phæophyceæ, four belong to the Dictyotales and twenty-five are Rhodophyceæ. In the case of seventeen forms, the genus only has been determined and in twelve neither the genus nor species is known.

Mr. F. S. Collins, Malden, Mass., has very kindly given valuable suggestions in this work and assisted with the identification of many forms.

Mr. Hoyt has preserved material for morphological work on certain forms and conducted experiments on the branching of *Dictyota dichotoma* induced by injury.

Mr. C. A. Shore, instructor in biology in the University of North Carolina, did for the Beaufort crustacea (exclusive of the amphipods and cirrepedes) this season what the year before he had done for the Annelids—the collection in the laboratory was gone over and, as far as was possible with the available literature on the subject, the specimens were identified. Poor specimens were replaced with perfect ones and specimens of unrepresented species were added when the opportunity afforded. According to the report made by Mr. Shore at the end of the season, the collection now contains specimens of ninety-one species of crustacea, seventy-seven of which are identified. The identification of four is doubtful. In the case of eight forms the genus only has been determined and two are entirely unidentified.

In the above number are included thirteen species collected in 1902 by the *Fish Hawk* from the region between Shackleford and Bogue Banks and the Gulf Stream.

Twenty-two species were added to the list this season and from the unclassified specimens already in the collection thirty-nine species were identified.

Mr. L. R. Cary, graduate student of zoology in the Johns Hopkins University, began work on the anthozoa. In connection with the regular natural history observations and collections, he recorded on charts, provided by the laboratory for the purpose, the local distribution and abundance of each species. His report for the season shows the collection to now contain specimens of eight species of *Alcyonaria*, nine *Actinaria* and three *Madreporaria*. This number does not include the species collected in 1902 by the *Fish Hawk* (two corals excepted), the work on this collection not having been completed. Mr. Cary also made observations on the budding of *Cylista leucolena* and will continue his study this winter on the structure and histology of this form and of the individuals developing from buds.

The actinian larva which has been found from time to time in the tow at Beaufort and which Mr. Cary succeeded in rearing last season and which he described in No. 1, Vol. VII., of the *Biological Bulletin*, has been identified as that of *Epizoanthus* *americana*, a species occurring in considerable abundance off the Beaufort Inlet.

Mr. E. W. Gudger, graduate student of zoology in the Johns Hopkins University, had charge of the work on fishes. In addition to the usual work of collecting systematically from various localities, Mr. Gudger undertook the work of determining to what extent the food of two of the most common food fishes, the spot (*Liostomus xanthurus*) and hogfish (*Orthopristis chrysopterus*) differs in different localities and whether local races are being established within each species. This work was not carried far enough to give data of value.

The list of fishes known to occur in the Beaufort region now numbers 134 species. Specimens of each species, with one exception, are preserved in the laboratory collection. In case the adult individuals of a species are very large, specimens of its young only are preserved supplemented with measurements of the adult. Thirteen species were added to the list this year, six of which it has not been possible to identify.

On account of the interruption to the work of investigation caused by visitors the laboratory room has recently been closed to them, but they are welcomed to all other rooms and buildings. In the museum hall the laboratory collections are arranged for inspection and several aquaria are kept supplied with living fishes and other forms of marine animals and plants. The maintenance and care of these exhibits was in charge of Mr. Gudger and the temporary assistant detailed to help with the work on fishes.

Mr. Gudger also continued to study the breeding habits and the early development of the pipe fish (*Siphostoma Louisianæ*). Material was preserved for a detailed study of the egg and young stages this winter.

Caswell Grave, associate in zoology in the Johns Hopkins University, continued to work on the echinoderms. A set of photographs of living specimens of each species is nearly complete. It is hoped that these may be published with the report on the natural history of the Beaufort echinoderms. By isolating the echinoderm larvæ taken in the 'tow' and rearing them through their metamorphosis into the adult form, the identity of several unknown larvæ has been ascertained and many interesting facts regarding the habits of the adults have been discovered. About ninety experiments on the segmenting egg and larva of *Ophiura brevispina* were made in order to study the regenerating capacity of this form in its early stages and to determine the influence which the considerable amount of yolk present in the egg has had on the localization of the germ layers and organ forming materials. The egg and larva of this species are favorable objects for this work in that they live well after injury and in that the eggs fertilized in the laboratory can be reared to the adult form. Experiments on the pluteus of *Mellita testudinata* showed that it lacks almost wholly the ability to regenerate lost parts.

THE INVESTIGATORS AND THEIR WORK.

Dr. George Lefevre, professor of zoology in the University of Missouri, occupied a table in the laboratory from June 15 to August 23. The brief account, given below, of the work done by him is extracted from his report to the director at the end of the season:

1. Artificial parthenogenesis was investigated in *Thalassema mellita* Conn. and it was found that the eggs of this worm could be induced to develop into freely swimming trochophores in the absence of sperm by immersion for a few minutes in very dilute solutions of several acids, both organic and inorganic. Nitric, hydrochloric, sulphuric,

carbonic, acetic and oxalic acids were used successfully, and in favorable experiments fifty to sixty per cent. of the eggs developed into swimming larvæ.

The larvæ arising parthenogenetically are strikingly normal in appearance and structure, and exhibit clearly marked cellular differentiations, as, for example, digestive tract, prototrochal band and apical plate with flagella.

A careful cytological and histological study of the material will be made, and the parthenogenetic development compared in detail with the normal.

2. Material was collected, photographs taken, and observations made in a systematic study of the tunicates of the vicinity of Beaufort.

Dr. Otto C. Glaser, Bruce fellow in the Johns Hopkins University, spent the entire season at the laboratory and engaged in experimental studies on the eggs of *Fasciolaria tulipa,* the natural history of nudibranch molluscs and a study of the development of *Aplysia* sp.?

Aplysias were extremely abundant this season, having been blown upon the Macon Beach and into the harbor by storms. They were actively breeding, and material for the study of the complete life history of the species was secured. Usually this animal is quite rare at Beaufort.

Dr. Glaser also had the supervision of the 'mess' and to his careful management is due the reduction in the price of board which it was possible to make this year.

Mr. Samuel Rittenhouse, graduate student of zoology in the Johns Hopkins University, beginning June 12, spent eight weeks at the laboratory, continuing the studies begun last season on the life history of *Turritopsis nutricula.* From the complete set of material procured he will be able to make a detailed study of the development of this form. He obtained material also for studies of the development of *Stomotoca apicata, S. rugosa* and an undetermined species of *Digonidia.* While gathering this material, by regular towings in various parts of the harbor, Mr. Rittenhouse made observations on the medusæ which appear at Beaufort and preserved specimens of each species. During this season and last he has collected about thirty species of hydromedusæ, seventeen of which are identified.

Mr. Howard E. Enders, professor of zoology in Lebanon Valley College and graduate student in the Johns Hopkins University, was at the laboratory twice during the year, from June 18 to August 6, and during the month of October. He continued his work to get the post-larval stages in the development of the tubicolous annelid, *Chætopterus pergamentaceus,* and collected material for an anatomical and histological study of the adult. Observations were made on the activities of the worm and its numerous commensals within the tube, and on the processes by which the tube is formed. The distribution of the animal in the harbor was charted.

Mr. Bartgis McGlone, professor of biology in the Illinois Wesleyan University, occupied a table in the laboratory for two months beginning June 26. He studied the breeding habits of *Mœra atropos,* the spatangoid so common at Beaufort, and discovered a method by which the eggs may be artificially fertilized. This result has been repeatedly worked for by several investigators without success, and the discovery by Mr. McGlone is a noteworthy contribution from the laboratory, for it opens to experimentation one of the most favorable objects for experimental study; the egg being small and very transparent and one in which the processes of maturation are postponed until extrusion from the body of the mother.

Mr. McGlone preserved material for a

study of the complete life history of the species.

Mr. B. A. Bean, curator of fishes in the National Museum, and his assistant, Mr. McKnew, spent two weeks at the laboratory, June 6–20, studying fishes and making a collection of certain forms for the National Museum. Mr. Bean went over the Beaufort collection of fishes and very kindly verified or corrected the doubtful identifications of some of the specimens. Tanks of alcohol were left by him at the laboratory, with a request that specimens of fishes taken this season, in duplicate, not collected by him, be preserved for the National Museum. This request was complied with.

Dr. J. I. Hamaker, professor of biology in the Randolph-Macon Woman's College, beginning August 18, spent two weeks in general collecting and in making observations on actinians.

CASWELL GRAVE.

SCIENTIFIC BOOKS.

Heredity of Coat Characters in Guinea Pigs and Rabbits. By Professor W. E. CASTLE. Carnegie Institution of Washington, Publication, No. 23. February, 1905.

This paper includes a careful account of the color varieties of domesticated cavies or guinea-pigs, of which the agouti, the yellow, the chocolate, the black, the albino, the spotted, the brindled, the roan and silvered, the long-haired and the rough-coated forms are described. Cross-breeding between many of these types was carried out and a detailed account of the results is given. Without attempting to review all of the many important results of this elaborate study of heredity a few of the more unusual or salient points may be indicated.

Albino or white guinea-pigs breed true, but crossing experiments with pigs of different colors show that individual albinos give different results, which is due, Castle believes, to the presence, in a greater or less degree, of *latent* pigment tendencies, which do not show up except in crossing. Thus the albino ♂ 2002 when mated with red females invariably produces offspring marked with black; while albino ♂ 1999 similarly mated produces only red (or yellow) offspring, never black ones. From these and similar results Castle makes a distinction between the two terms *latency* and *recessive.* Latency "is a condition of inactivity in which a normally *dominant* character may exist in a *recessive* individual. It is questionable whether a recessive character may ever be latent." Recessive is used in Mendel's sense to designate a character "which disappears when brought by fertilization into the same (hybrid) individual with a contrasted 'dominant' character, but which is transmitted, distinct from the dominant character, in half of the gametes formed by the hybrid individual."

As is well known pure albino animals have pink eyes. This means that pigment is absent from the eyes as well as from the skin. Now pure white guinea-pigs and mice are known having black eyes. These are not albinos but 'spotted' animals, in which the pigment spots have been so far reduced as to be practically obliterated, except in the eyes. The black-eyed white animals that appeared in Castle's experiments did not breed true, since spotted offspring often cropped up. Whether by prolonged selection they could be made into a pure race can not be stated, but Castle thinks it not impossible. When mated to pure albinos spotted offspring are produced.

Guinea-pigs with a rough coat are animals whose hair is arranged in rosettes or 'cowlicks' around certain centers. Nine such centers can be recognized in individuals with the best developed rough coats. In crossing these roughs with ordinary or smooth-haired forms the rough character is dominant. Here we have another interesting instance of a recently acquired character dominating in the offspring. The rough character is as fully developed as in the rough parent. The offspring of these rough hybrids follow the Mendelian ratio, provided the *degree* in which the rough character is developed in the offspring is left out of consideration. Just here, however, comes a curious result, that is of the utmost importance in the debated question of discontinuous *versus* blended inheritance. Although, as has just been said, the rough coat dominates in the first generation of hybrids (rough $\times$ smooth), yet sometimes it shows a weakened condition; and what is even more interesting is that certain smooth individuals which may be said to be prepotent show a stronger tendency to weaken the rough coat than do other individuals. Such partially rough individuals may later transmit the rough character to their offspring in its full intensity. Again, repeated crossing of rough animals with prepotent smooth ones leads to a further weakening of the rough coat until it may be almost eliminated. Here are some nuts to crack for those who believe the Mendelian purity of the germ cells depends on the elimination of maternal or paternal chromosomes *which have never mixed* during their sojourn in the same nucleus!

Another apparent Mendelian inconsistency is found in the ratio of inheritance of the long coat, which is dominated by the short, or ordinary coat. In the second generation of inbred hybrids the proportion of long coated individuals exceeds the expected number.

An interesting point in regard to heredity in rabbits is shown when pure white and Himalayan rabbits are crossed. The Himalayan character dominates in the first generation only *imperfectly,* yet complete segregation of the characters takes place in the germ-cells, so that the two pure parent types reappear in some of the offspring.

For other important facts the paper itself must be consulted. That some of the conclusions are only tentative the author himself fully realizes. The constant attention and great labor involved in an extended experiment of this sort will be appreciated by those who have had experience in such matters, and we can confidently expect the future to bring forth many important results from these pedigree animals. Already enough 'problems' are indicated to engage many other workers who have the opportunity, the patience and the skill to give to investigation of this sort. Carefully recorded histories, such as is given for these hybrids, are invaluable to science. Professor Castle is to be much congratulated upon his admirable work.

T. H. Morgan.

Columbia University.

The Stone Reefs of Brazil, their Geological and Geographical Relations, with a Chapter on the Coral Reefs. By John Casper Branner. Bulletin of the Museum of Comparative Zoology, Vol. XLIV. (Geological series, Vol. VII.). Cambridge, Mass. May, 1904.

This important memoir treats of a geological phenomenon that has not hitherto received the attention that its importance and interest, both commercial and scientific, deserve. A port formed by a stone reef harbored in 1500 the fleet of the first Portuguese discoverers of Brazil and the impression produced by it on their minds is strikingly shown by the fact that they applied to it a descriptive title, 'Porto Seguro,' instead of a name taken from the Saint's Calendar, as was the almost universal custom of the early Iberian explorers. From this point as a center a considerable section of the Brazilian coast region was explored and peopled, while two other stone-reef-protected ports, Recife (Pernambuco) and Rio Grande do Norte, became equally or even more important in the history of the early development of the country. The first of these has retained its commercial importance to the present day, and, being situated on a great line of travel, has attracted the attention and excited the wonder of all mariners and travelers who have visited the Brazilian coast. The former very naturally confounded the reefs formed by sandstone with those, still more frequent along this coast, composed of coral rock, and the latter have repeated the sailors' statements to the effect that a large section of the coast is bordered by a reef of the same nature as that of Pernambuco.

The first to accurately describe the Pernambuco reef as a consolidated bar of sand was Darwin, who touched there in the celebrated voyage of the *Beagle.* Hartt, in 1870, showed that the reputed great barrier reef of Brazil was a myth, though detached reefs, both of coral and of sandstone rock, occurred at numerous points; the latter being due to a superficial consolidation of beach sands which is substantially limited by the planes of high and low tide. The examples of these curious structures hitherto described were in the immediate vicinity of Pernambuco and along the section of coast to the southward of Bahia. The present memoir besides beautifully illustrating those already known with nearly 100 maps and photographs, gives full details of a large number of others between the points above mentioned and to the northward of Pernambuco as far as Rio Grande do Norte. The most southerly one known is at Guarapary in the state of Espirito Santo and from this point to Rio Grande do Norte, a distance of about a thousand nautical miles, the sandstone reefs can now be considered as definitely known. To the southward it is tolerably certain that no more exist, but in the nearly equally long stretch of coast from Rio Grande do Norte to the Amazonas they may be presumed to be about as abundant and characteristic as in the section above mentioned, and it is much to be desired that this northern section should be examined in the same careful manner.

Dr. Branner, after fully describing and illustrating the reefs examined to the number of over twenty, sums up their characteristics as follows:

> The stone reefs are nearly but not quite straight. The bedding of the material dips seaward at the same angle as ordinary beach sands. The hard rock of the reef is only three or four meters thick. The underlying materials are sands, shells and clays without regular sequence. The process of formation, the character and the structure of the reefs show that they are ancient beaches hardened by lime carbonate, while their straightness shows that they are forms of a mature beach line fixed and made permanent by the process of consolidation pointed out in Part VI.

The most puzzling problem presented by these reefs is that of their consolidation through the deposition of lime carbonate, and one of the most interesting chapters of the memoir is devoted to its discussion. The hypothesis of the hardening of beach sands through the action of rain water and through the escape of carbon dioxide contained in sea water is admitted as possible, but put aside as insufficient to account for all the phases of the phenomenon. The coincidence of the distribution of the stone reefs with an area of greater density of the oceanic waters is noted as a possible concurrent cause. (Another coincidence worthy of note is that of the distribution of the sandstone and coral reefs.) A more efficient cause is thought to be the seeping of fresh water charged with organic acids from the decay of vegetable matter accumulated in the lagoons and repressed streams behind beach ridges. The reefs occur along a section of coast swept by tolerably constant winds and currents, and with such geologic and climatic conditions that many streams are temporarily or permanently closed by the formation of beach ridges, so that their waters, becoming charged with organic acids, have to find their way to the sea by percolation through the barriers of beach sands. In conclusion the author remarks: "It seems probable that the consolidation of the reef sands would not take place if the rainfall were large enough and constant enough to keep the mouths of the streams open and the waters of the streams fresh" [pure].

In a chapter on coast changes evidences of both elevation and depression in late geological times are presented and discussed. A depression of considerable importance is presumed to have taken place in early Pliocene times, followed by a smaller elevation. The sandstone reefs were formed and hardened subsequent to the depression, but there is no evidence that they have suffered any appreciable movement since their formation. The reefs, both sandstone and coral, have protected the land and helped build out the shores.

In an introductory chapter a brief sketch of what is known of the geology of the coast along which the reefs occur is given. In this Dr. Branner takes issue with his predecessors, and with his own previous writings, by referring to the Tertiary a considerable portion of what has been considered as Cretaceous. The evidence for this change of view is, however, confessedly inconclusive, and to the reviewer it seems that some contrary evidence of importance has been overlooked or unduly minimized.

The chapter on coral reefs is also a valuable contribution to our knowledge of the physical and geological conditions of the same section of the coast, as hitherto the only scientific studies of the Brazilian coral reefs were those of Hartt on the reefs near the Abrolhos and of Rathbun on that of Itaparica in the bay of Bahia. The coral reef-fringed section of the Brazilian coast extends from near the equator to 18° south latitude, but for nearly half of this long line, from Rio Grande do Norte northward, the various types of reef—sandstone, coral and underlying rock—can not at present be discriminated. The coral reefs are broken by many and large gaps, for some of which no apparent reason can be given. With the exception of the Rocas, which seems to be a true atoll rising from deep water, all the reefs are built up on the submerged continental shelf and are fringing and barrier reefs. They are usually narrow, ten to fifty meters in width, but in the case of the large barrier reefs may attain a width of thirty kilometers. The near-shore reefs are quite thin, probably not exceeding a thickness of ten meters, and a hundred meters is presumed to be the maximum thickness of the outlying barrier reefs.

For the most part the reefs have reached the upper limit of growth and are now dead on top, though still growing laterally. None, however, are known that have been elevated above tide level. In age they are presumed to date back to Tertiary times, since they rise from a shelf due to a great depression presumed to be of early Pliocene date. Coral rock has been observed both beneath and on top of sandstone reef rock and possibly some coral reefs rise from a base furnished by submerged examples of sandstone reefs. The coral polyp fauna found on the reefs contains twenty-eight species and is more closely related to that of the West Indies than to any other known coral fauna.

One of the points of greatest geological interest brought out by this study of the coral reefs is that a process of dolomitization of the reef rock is going on in the open sea, thus rendering unnecessary the 'salt-pan' hypothesis that has been appealed to in the cases hitherto noted of a higher proportion of magnesia in rocks of coral origin than in the skeletons of the corals themselves.

Dr. Branner states that the opportunity for completing his reef studies, commenced many years ago, was provided by Professor Alexander Agassiz. Both these gentlemen are, therefore, to be congratulated on the importance of the results achieved and presented in this splendid memoir, and it is greatly to be desired that these results will stimulate them to promote a similar study of that biologic and geologic *terra incognita,* the northern section of the reef-bound Brazilian coast, which, on account of the peculiar conditions of winds and currents, can only be explored by the use of steam vessels. ORVILLE A. DERBY.

COMMISSAO GEOGRAPHICA E GEOLOGICA DE SÃO PAULO, BRAZIL,
December 26, 1904.

SCIENTIFIC JOURNALS AND ARTICLES.

THE April number (volume 11, number 7) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the February Meeting of the American Mathematical Society, by F. N. Cole; Report of the December Meeting of the Chicago Section, by T. F. Holgate; 'Mathematics at the St. Louis Congress, September 20, 22 and 24, 1904,' by H. S. White; 'The Use of Hypercomplex Numbers in Certain Problems of the Modular Group,' by J. W. Young; 'Extension of a Theorem due to Sylow,' by G. A. Miller; 'Note on Isothermal Curves and One-Parameter Groups of Conformal Transformations in the Plane,' by C. L. Bouton; Review of Arendt's Dirichlet's Definite Integrals, by Virgil Snyder; 'The Theta Functions' (Review of Krazer's Thetafunktionen and Rost's Riemann'sche Thetafunktionen), by J. I. Hutchinson; Review of Hilton's Mathematical Crystallography, by R. P. Baker; 'The Theory of Electricity' (Review of Abraham and Föpple's Theorie der Elektricität), by E. B. Wilson; Notes; New Publications.

THE April number (volume 6, number 2) of the *Transactions of the American Mathematical Society* contains the following papers:

E. J. WILCZYNSKI: 'General projective theory of space curves.'

Maurice Fréchet: 'Sur les opérations linéaires (deuxième note).'

E. Kasner: 'Surfaces whose geodesics may be represented in the plane by parabolas.'

Max Mason: 'The doubly periodic solutions of Poisson's equation in two independent variables.'

O. Veblen: 'Definition in terms of order alone in the linear continuum and in well-ordered sets.'

S. Epsteen and J. H. Maclagan-Wedderburn: 'On the structure of hypercomplex number systems.'

E. H. Moore: 'On a definition of abstract groups.'

E. V. Huntington: 'Note on the definitions of abstract groups and fields by sets of independent postulates.'

L. E. Dickson: 'Definitions of a group and a field by independent postulates.'

L. E. Dickson: 'On semi-groups and the general isomorphism between finite groups.'

E. V. Huntington: 'A set of postulates for ordinary complex algebra.'

H. F. Blichfeldt: 'On imprimitive linear homogeneous groups.'

SOCIETIES AND ACADEMIES.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

The eleventh regular meeting of the Society for Experimental Biology and Medicine was held in the zoological laboratory of Columbia University, on Wednesday evening, April 19. The president, Edmund B. Wilson, was in the chair.

Members present.—Adler, Auer, Calkins, Emerson, Gies, Hatcher, Jackson, Lee, Levene, Levin, Lusk, Meltzer, Morgan, Murlin, Richards, Salant, Sherman, Torrey, Wallace, Wilson, Wolf, Yatsu.

Members elected.—Harlow Brooks, W. B. Cannon, A. J. Carlson, R. G. Harrison, A. P. Mathews, G. H. Parker, A. E. Taylor.

ABSTRACTS OF REPORTS OF ORIGINAL INVESTIGATIONS.*

The Relation Between Normal and Abnormal Development of the Frog's Egg: T. H. Morgan.

The method of development of the frog's egg may be changed by a number of external conditions, *e. g.*, treatment with salt solutions of definite strengths, variations of temperature, deprivation of oxygen, treatment with carbon dioxid, subjection to 180 revolutions per minute, etc. The effects of such external agents are not gradual, *i. e.*, corresponding in degree to the increasing strength of the agent employed, for no effects appear up to a certain point, when suddenly the agent begins to act. Increasing the strength of the agent above this point increases the effect very slightly. The most plausible explanation of this mode of behavior in most of the cases is as follows: The agents act by coagulating certain parts of the egg, thereby preventing their further development. Other parts of the egg that are made up of different colloids or of different concentrations of colloid, remain unaffected, and proceed to carry out their development as far as the presence of the injured region allows.

The author referred particularly, however, to a second point of special interest: Despite the great diversity in the form of the abnormal embryos, most of them may be reduced to modifications of the same type. He stated that the abnormal embryo develops in the material of the upper hemisphere, while the normal embryo develops over the lower hemisphere. Two interpretations of this difference seem possible. Either the material is totipotent and an embryo may develop anywhere in the egg, appearing in the less injured regions; or the material for normal and abnormal development is the same and becomes carried downward, during the early stage of normal development, from the upper into the lower hemisphere. A test of these alternatives showed that when the two upper anterior blastomeres are removed, the head end of the embryo is defective; when the two upper posterior blastomeres are removed the posterior end sometimes shows defects. When all four of the upper blastomeres are removed no embryo develops, although the blastoporic rim may appear near the equator of the egg, the gastrulation process may begin and the dif-

* The abstracts presented in this account of the proceedings have been greatly condensed from abstracts given to the secretary by the authors themselves. The latter abstracts of the reports may be found in current issues of *American Medicine* and *Medical News*.

ferentiation of the germ layers take place to a certain extent.

The author concluded from these results that some at least of the material that goes to form the embryo lies at first high up in the upper hemisphere of the egg. In the light of this conclusion it became necessary to examine once more the early development, especially the pregastrula stages, for no one has suspected that the embryo-forming material lies in the upper hemisphere and is transported to the lower hemisphere *before* the lips of the blastopore have appeared.

Briefly, the author's examination showed that throughout the early period of segmentation, the material of the upper hemisphere gets pushed far out to the sides of the egg. This is brought about largely by the development of the enormous segmentation cavity. During the later cleavage period the yolk cells of the lower hemisphere push upwards into the segmentation cavity, almost obliterating it. This upward movement of the cells in the interior is compensated for by the moving downwards below the equator of the outer layers of the egg. In this way the embryo-forming material is carried into the lower hemisphere. Along its edge the lips of the blastopore develop. The dorsal, lateral and ventral lips roll over the yolk (or more accurately, the yolk draws in beneath their advancing lips) and the dorsal organs of the embryo (the embryo in a narrower sense) appear over the lower or yolk hemisphere of the egg.

Rejuvenescence in Protozoa: Gary N. Calkins.

Since 1876 it has been generally assumed that one effect of conjugation is rejuvenescence or renewal of vitality in both of the ex-conjugants. This assumption has never been proved experimentally. In his Paramœcium work, begun in 1901, the author almost had the proof, but allowed the opportunity for obtaining it to pass without realizing it at the time. In order to complete the earlier work a new series of experiments with Paramœcium was started on the last day of February (1905), consisting of three different lines, at present in about the fortieth generation after conjugation. In his original experiments the author found strong evidence against the old view that both ex-conjugants are rejuvenated. In twenty pairs which were cultivated after separating from conjugation, at least one individual of each pair invariably died before many days, thus indicating an incipient fertilization like that in metazoa. This phenomenon will be given careful study in the experiments now under way.

Temperature and Muscle Fatigue: Frederic S. Lee.

Lohmann has recently claimed that a cold-blooded muscle on being heated to a mammalian temperature shows a course of fatigue similar to that of mammalian muscle, and, on the other hand, that a warm-blooded muscle on being cooled fatigues like the muscles of cold-blooded animals at a similar temperature. The author was unable to confirm Lohmann's results, and maintains his own previous conclusion that the contraction process of the muscles of cold-blooded animals in the course of fatigue becomes greatly slowed, while those of warm-blooded animals show no such phenomenon. The muscles of the frog and the turtle show their characteristic method of fatigue whatever the temperature. The muscles of warm-blooded animals on being cooled and then fatigued show either no slowing of the contraction process or only a slight slowing. The latter seems to be most pronounced in the rodents, namely, the rabbit, mouse and rat.

On Intraureteral Pressure and its Relation to the Peristaltic Movements of the Ureter, with demonstrations. Daniel R. Lucas. (By invitation.)

The author has observed that suction normally follows the peristaltic wave of the ureter; at the same time a force is exerted on the fluid in front of the wave. The force of the peristaltic wave was seen to raise a column of water of considerable height. When the ureter is acting normally, the pressure in the pelvis of the kidney remains constantly negative, the anatomical arrangement of the pelvis preventing collapse under negative pressure. These facts indicate that the ureter functions, to some extent at least, as an active agent in the formation of urine, for the latter is in part a filtration process.

Further Observations upon the Phosphorized Fats in Extracts of the Kidney: Edward K. Dunham. (Presented by P. A. Levene.)

The author has found that beef kidney yields protagon to the extent of 0.14 to 0.2 per cent. of its weight (fresh). The protagon was obtained by the method recently used by Cramer (*Journal of Physiology,* 1904, XXXI., p. 31). On comparison with the protagon obtained by the same method from beef brain, it was found that the substance from the kidney contained distinctly more nitrogen and phosphorus than that from the brain. The cleavage products, however, showed that both substances are closely related. The following percentage analytic data were obtained by Dr. Levene:

	From Beef Kidney. (1)	(2)	From Beef Brain.	Cramer's Data for Beef Brain Protagon.
C	65.61	65.55	65.76	66.25–66.42
H	11.00	11.09	10.66	10 82–11.07
N	3.16	3.25	2.51	2.29
P	2 06	2.19	0.97	1.04
S	0.82	—	1.33	0.71

Comparative Physiological Action of Salts of Neodymium, Præseodymium and Lanthanum: B. J. Dryfuss and C. G. L. Wolf.

The experiments were carried out in vitro and on unicellular organisms, bacteria and infusoria, frogs, pigeons, rats and guinea pigs. The solutions used were chiefly the chlorids, isotonic with 0.6 per cent. sodium chlorid. Dilute solutions were found to delay the growth of bacteria and eventually to kill. The solutions were not very toxic to spores. Opalina, paramœcia and vorticellæ were killed quickly, equivalent solutions of the chlorids acting in the following order of strength: neodymium, præseodymium and lanthanum. In frogs, voluntary and involuntary muscle are quickly put out of action. The solutions act in the same order as with unicellular organisms. Intravenous injection caused almost instant death, due to multiple embolism. Attempted chronic poisoning gave unsatisfactory results. The authors attribute a large share of the acute effects observed to the acid present in their solutions owing to the hydrolytic dissociation of the salts.

The Influence of Bile upon Blood Pressure: S. J. Meltzer and William Salant.

The authors found that all degrees of effects could be produced at will, from an insignificant one to a considerable, even a fatal, fall of blood pressure. Besides the quantity and the concentration of the bile it was found that the *rate* at which it is introduced into the circulation is the most effective factor in the result. A quantity of bile of a given concentration, which, when injected *slowly,* would cause only an insignificant depression, brought about a very great fall of the blood pressure when injected *rapidly.* In control experiments it was found that the mechanical and thermal conditions attending the injections had no observable influence on the pronounced effects noted above. Previous conflicting statements regarding the influence of bile on blood pressure may be attributed, therefore, to results due to different *rates* of injection. This factor, clearly recognized in other connections, had always been ignored in this.

It is probable that the bile exerts an inhibitory effect upon the heart. The authors have shown that the action on the heart is not due to malnutrition caused by hemolytic influences.

A Report of Feeding and Injection Experiments on Dogs after the Establishment of the Eck Fistula: P. B. Hawk. (Presented by A. N. Richards.)

Mixed diets were not attended by abnormal symptoms. Diets consisting of beef meal and milk or of fresh lean beef alone were followed by ataxia, loss of sight and hearing, complete anæsthesia and catalepsy. In some cases, however, these effects were noted only after the addition of Liebig's extract to the meat diet. The administration to normal dogs of sodium carbamate, either by mouth or by intravenous injection, gave rise to none of the symptoms observed by Pawlow and Nencki.

On Chemical Fertilization: Jacques Loeb. (Presented by William J. Gies.)

The author found that when unfertilized eggs of the sea urchin were exposed for about one to two minutes to 50 c.c. of sea water, to which about 3 or 4 c.c. of $n/10$ acetic acid had been added, the majority of the eggs formed the membrane characteristic of the entrance of the spermatozoon. When these eggs were exposed for from thirty to forty minutes to 100 c.c. of sea water to which 14 or 15 c.c. of a $2\frac{1}{2}$ n solution of sodium chlorid had been added, those of the eggs which had formed membranes developed into swimming larvæ that rose to the surface. These larvæ developed into perfect plutei as fast as the larvæ of eggs fertilized with sperm. When the order of treatment was reversed, not a single larva was formed. When eggs were fertilized with sperm first and then exposed to the hypertonic sea water for from about thirty to forty minutes, their development became almost identical with that of the unfertilized eggs treated first with acid and then exposed to the hypertonic sea water for the same period of time.

The acid treatment above referred to causes the formation not only of the membrane, but also, in due time, of the karyokinetic spindle. Eggs exposed for only thirty or forty minutes to the hypertonic sea water do not show any changes of any kind. Following the action of the acid, however, treatment with hypertonic sea water appeared to accelerate the mechanism of cell division originated by the acid treatment, and also seemed to increase the vitality or to prolong the life of the egg.

William J. Gies,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 599th meeting was held April 1, 1905.

In a communication made by Mr. R. A. Harris, entitled 'A General Account of the Tides,' brief mention was made of the disturbing forces and the ordinary ways of producing the tide. A small deep body of water may obey the equilibrium theory, *i. e.,* its surface may always be normal to gravity as disturbed by the moon or sun. This theory nearly explains the tides in Lake Superior, the eastern half of the Mediterranean Sea, the southwestern portion of the Gulf of Mexico and of the Caribbean Sea. The ocean tides are due chiefly to stationary waves, or oscillations, existing in such portions of the ocean as have for free period approximately the period of the tidal forces. The motion is thus sustained on a considerable scale, just as is the motion of the air particles in a resonator tuned to a sound of constant pitch.

The principal systems for the semidaily tide were shown on maps, and attention called to the loops and nodes of the oscillating areas. By means of maps of cotidal lines (taken from the Coast Survey Report for 1904) it was shown that over wide areas the tide is nearly simultaneous, while in certain localities the time of tide changes rapidly. In many instances the former regions correspond to loops of the stationary waves, while the latter give indications of nodal lines. Attention was called to isolated points at which there is no rise and fall of tide. Around such points the hours, or times, of the tide run through a complete cycle of values, from 0 to XII. or 0. Such points may be due to the superposition of stationary waves, or to other forms of wave motion; in narrow bodies the deflecting force of the earth's rotation is influential in their production. It was shown that both times and ranges give evidence of the existence and location of these points.

Mr. John F. Hayford then spoke on 'A Test of Isostasy from Geodetic Observations.' According to the theory of isostasy excesses of mass represented by portions of the earth which are above sea level are compensated for by defects of density beneath them, and similarly the density is excessive beneath the oceans. The test referred to is being made in connection with a new computation of the figure of the earth based upon geodetic observations in the United States, which is now in progress in the Coast and Geodetic Survey. The test furnishes a direct proof that the theory of isostasy is true as applied to the northeastern portion of the United States, and also furnishes a determination of the depth of compensation.

Charles K. Wead,
Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 399th regular meeting of the Biological Society of Washington was held March 11, 1905, with President Knowlton in the chair and eighty-seven persons present. Under 'Notes and Exhibition of Specimens,' Dr. L. O. Howard exhibited specimens of various products of artificial silk, and briefly explained the process of preparation and weaving. This note was discussed by Mr. W. P. Hay. Mr. E. L. Morris called attention to the recently issued edition of Cassino's 'Naturalists' Universal Directory'; and noted the very large number of errors which are scattered through the work. He suggested the advisability of the scientists in a city like Washington taking some steps to have such errors as much reduced in number as possible. Mr. F. H. Blodgett exhibited a microscope slide of a common ant mounted in toto, in xylol and balsam, in normal position, showing clearly such anatomical characters as the attachment of the head to the thorax. This preparation was discussed by Mr. Morris. President Knowlton called attention to a recent paper containing facts concerning the salts found in human blood.

The regular paper of the evening was by Professor Willett M. Hays, assistant secretary of agriculture, on 'Breeding Problems.' He said:

Of the $5,000,000,000 worth of agricultural products annually produced in the United States, $4,000,000,000 worth is handled by plant and animal life. This production may be increased by (1) better farming ten per cent. and (2) by breeding ten per cent. Increased returns from better farming cost more than equal increased returns from breeding. Ten per cent. of $4,000,000,000 is $400,000,000 and this can be produced at a cost very small as compared with the total increase.

Improvements through breeding can not be patented or monopolized. The problem, therefore, is a national one and national funds should be forthcoming with which to facilitate the work of investigation, growing, testing, recording and distributing improved varieties and breeds. The work already done by the Department of Agriculture, the experiment stations and by private effort sufficiently justifies such large expenditures, and the money is not far off. It would seem wise to have the ownership of the plants and animals under process of improvement vested in private hands, the government giving general direction and subsidizing the operations.

A broad plan of cooperation must be worked out. Plant and animal breeders are well started in cooperation through the medium of the American Breeders' Association, organized a year ago and soon to publish its first annual report.

The problems in breeding now up for solution are worthy of the highest scientific effort. The technique of breeding, growing and distributing pure bred stocks of the different crops and animals calls for skill and business ability of a high order. The study of thermatology in agricultural high schools and colleges is fascinating and most valuable. The economic importance of breeding demands serious attention from the whole people.

The 400th regular meeting of the Biological Society of Washington was held March 25, 1905, with Vice-President Hay in the chair and seventy-seven persons present. Under 'Notes,' Mr. M. W. Lyon, Jr., spoke of having observed twelve dead crows during a short walk in the Soldiers' Home grounds, and commented on the large number for so small an area. Dr. B. W. Evermann stated that three weeks previous, in a grove of pines, he had observed seven. Dr. E. A. Mearns noted that such deaths were epidemic, especially in the neighborhood of Fort Meyer. Many of the specimens observed had been sent to the Smithsonian Institution as probable cases of malarial fatality. Mr. William Palmer stated that after every snow, especially if more than two weeks' stand, the crows died by the score. Dr. L. O. Howard emphasized the fact that these were largely malarial cases. Mr. W. L. McAtee called attention to the large amount of food suitable for birds he had noted during the winter in heaps of drift. He stated that in one heap alone he had counted 1,583 specimens of seeds, etc., all of which were available as bird food.

The first regular paper of the program was by Dr. Hugh M. Smith, presenting 'Ichthyologia Miscellanea' as follows:

1. The proper name for the blue-gill sunfish. This species is now known as *Lepomis pallidus* (Mitchill). Dr. Smith showed that Mitchill's name *pallidus* (1815) can not be appropriated for this fish, as the description does not apply and the species is not found near New York City, the type locality of *pallidus*. The earliest available name for this sun-fish is *incisor* of Cuvier and Valenciennes (1831), and the species should be known as *Lepomis incisor* (Cuvier & Valenciennes).

2. Note on a rare flying-fish (*Cypselurus lütkeni*). The speaker recorded the capture of the second known specimen at Beaufort, N. C., in 1904. The source of the type specimen, now in the Philadelphia Academy of Sciences, is doubtful, but the indications are that it, too, came from Beaufort about 1871.

3. The feeding habits of the trigger fish (*Balistes vetula*). These habits had been observed on a captive specimen at the Woods Hole Laboratory. Dr. Smith described in detail how this fish attacked, killed and ate its food consisting largely of a certain species of crab.

This paper was discussed by Dr. Evermann.

The second paper was by Mr. A. G. Maddren, 'Notes on the Occurrence of Mammoth Remains in Alaska.'

In introductory remarks an outline was given of a trip the speaker made last summer in the interests of the Smithsonian Institution to Alaska with the purpose of searching for the remains of large Pleistocene mammals, particularly those of the mammoth, which are popularly supposed to be abundant in that region, but actually do not exist in any great numbers. The entire length of the Yukon River was traversed and one of its largest tributaries, the Porcupine, was ascended to the Old Crow River, in the basin of which stream abundant evidence of Pleistocene mammal remains were found.

Attention was called to the fact that Pleistocene mammal remains appear to be no more abundant in Alaska than in the United States, and to find complete remains of the mammoth and associated mammals search must be made around the former shore lines of the Pleistocene lacustrine deposits that are considerably developed in Alaska.

A historical summary of the records of the occurrence of mammoth remains in Alaska was given and the statement made that there is no formation of ice in Alaska that may be assigned to the Pleistocene age, as has been stated by some writers, but that all the ice phenomena there occurring are, geologically, comparatively recent.

The concluding remarks favored the view that Alaska, from a geographical standpoint, was in Pleistocene time part of Asia; that its fauna had closer affinities to that of Asia than to the contemporary fauna of the United States and that if sufficient material were at hand to institute a close study it would be found that *Elephas primigenius*, the true Siberian mammoth, never lived in the United States, which was occupied by three distinct species of fossil elephants, the form most closely related to the Siberian mammoth (*E. primigenius*) being *Elephas jacksoni*, the others being the more easily distinguished forms *Elephas columbi* and *Elephas imperator*.

The last paper was by Dr. A. D. Hopkins on 'Ornaments and Blemishes in Wood, Caused by Insects and Birds.'

Dr. Hopkins stated that the object of the paper was to discuss the causes of some of the ornamental conditions and blemishes commonly seen in the wood of trees and their crude and finished products.

The blemishes appear in lumber and woodfinish as discolored spots, checks, dark stains, resin deposits, pin holes, worm holes, etc., and in the trees as scars, decayed spots and hollow trunks.

The ornamental conditions appear in the lumber and inside finish and furniture as so-called bird's-eye, curly, burl and wavy or satined effects, and on the surface of the wood beneath the bark as artistic and curious carved and embossed work.

It would be difficult to find a recently constructed public building or private residence which does not show in the natural wood finish one to many blemishes, the results of many causes. Most of them, which are not natural conditions in the wood, are caused primarily by insects, birds and various other agencies, which produce wounds in the cambium of the living tree. When we are able to identify these blemishes with the species of bird or insect that caused them, they become objects of interest. Certain bird's-eye and curly effects are even more interesting, because more pleasing to the eye, and the exact cause is more obscure.

The object of the study of woodpecker work in living trees was to determine characters by which the subsequent results from wounds made by them in the living cambium could be identified from those caused by insects and other agencies; also to determine the relation of the birds and their work to subsequent injuries by insects, or the reverse.

The material collected by him during the past fourteen years represents some forty species of forest trees, of many genera and families, and from widely different sections of the country.

It appears that the object of the sapsucker working in the bark of living trees is to secure both liquid and solid food from the sap, cambium and bast, and not for the purpose of collecting insects, or, at least, not primarily for that purpose.

The punctures in the bark vary in size, form and arrangement, according to the species of tree and the character of the food furnished. In the pine, spruce, hemlock, juniper, and probably in all conifers, the desirable substance is furnished by the living bast tissue and cambium, while the wood yields resin instead of sap, therefore the birds have no occasion to puncture the outer wood-ring, and very rarely do so, whereas in maple, walnut, hickory and such trees as furnish at certain times of the year a prolific flow of saccharine sap from the sapwood, the outer ring of wood is always punctured. In the former, the wounds are usually broad, often connected, and usually arranged in longitudinal rows, while in the latter they are narrow, funnel-shaped, rarely joining, and arranged in transverse rows.

The method of healing of these wounds is quite variable, being influenced not only by the character of the wound, but by the species or genus of trees in which they occur.

The resulting defective or ornamental conditions and subsequent annual layers of wood also vary in character and economic importance with different kinds of trees and commercial products.

While the healed wounds made by the birds cause a bird's-eye effect in the finished surface, they are not responsible for all bird's-eye wood. The small densely placed bird's-eye in maple is not caused by birds, but appears to be a character peculiar to certain individual trees, while that resulting from the work of birds is coarser, less distinctly defined, more sparsely arranged, and the wood in which it occurs usually shows small dark spots or streaks where the original wound was made in the living cambium.

Specimens of blemishes, bird's-eye and stained effects caused by birds and insects in many kinds of wood were shown, together with some forty stereopticon slides.

Attention was called to the knotty walking sticks, umbrella handles, crops, etc., which represent an extensive industry, in which the desired knotty effect is produced artificially by making wounds with a sharp instrument in the living bark and cambium of the growing stem, which is left to grow one year and heal the wounds before cutting the stick and removing the bark. This result is similar to that from a wound made by a sapsucker, which may have suggested the idea.

E. L. Morris,
Recording Secretary.

MICHIGAN ORNITHOLOGICAL CLUB.

The annual meeting of the Michigan Ornithological Club was held in the museum of the University of Michigan at Ann Arbor on April 1, 1905. A business meeting was held in the forenoon in the curator's office. The following officers were elected for 1905–6.

President—Walter B. Barrows.
First Vice-President—A. H. Griffith.
Second Vice-President—James B. Purdy.
Third Vice-President—J. Claire Wood.
Secretary—Alexander W. Blain, Jr.
Treasurer—Frederick C. Hubel.

Editorial Staff of the Bulletin: Editor, Walter B. Barrows; *Associates,* P. A. Taverner, Norman A. Wood.

The afternoon session was held in the university lecture room. The meeting was called to order by Professor Barrows, who addressed the society on 'Recent Advances in Ornithology.' The following program was then presented:

Leon J. Cole: 'In Memoriam—Albert Bowen Durfee' (read by J. Wilbur Kay in the absence of the author).

Norman A. Wood: 'Birds Noted En route to Northern Michigan.'

Otto McCreary: 'Ecological Distribution of the Birds of the Porcupine Mountains, Michigan.'

Max M. Peet: 'Observations on the Nesting Habits of a Pair of House Wrens.'

Alexander W. Blain, Jr.: 'On the Use in Surgery of Tendons of the Ardeidæ and Gruidæ.'

Norman A. Wood: 'Some New and Rare Records for Michigan.'

Earl H. Frothingham: 'A List of Birds from the Michigan Forest Reserve, Crawford County.'

Leon J. Cole: The Occurrence of Bewick's Wren, *Thryomanes bewickii* (Aud.), at Grand Rapids (read by Wm. H. Dunham).

P. A. Taverner: 'A Preliminary Notice of an Interesting Migration Route.'

Alexander W. Blain, Jr.,
Secretary.

THE AMERICAN MYCOLOGICAL SOCIETY.

The American Mycological Society met in affiliation with the American Association for the Advancement of Science at Philadelphia, December 28–31. The following officers were elected:

President—Charles H. Peck.
Vice-President—F. S. Earle.
Secretary-Treasurer—C. L. Shear.

The following committee on organization and relation to the other societies was appointed by the president: C. L. Shear, S. M. Tracy and Dr. Roland Thaxter.

The following program was presented:

Charles Thom: 'Suggestions for the Study of Dairy Fungi.'

Geo. G. Hedgcock: 'A New Disease of the Cultivated Agave.'

J. C. Arthur: 'A Study of North American Coleosporiaceæ.'

E. J. Durand: 'Classification of the Geoglossaceæ.'

J. C. Arthur: 'The Terminology of the Spore Structures in the Uredinales.'

E. A. Burt: 'Generic Characters of North American Thelephoraceæ.'

Perley Spaulding: 'Cultures of Wood-Inhabiting Fungi.'

G. F. Atkinson: 'Two Fungous Parasites on Mushrooms.'

G. F. Atkinson: 'The Genus *Balansia* in the United States.'

DISCUSSION AND CORRESPONDENCE.

AUBUBON'S ACCOUNT OF THE NEW MADRID EARTHQUAKE.

Within the last few years there has been a reawakening of interest in the New Madrid earthquakes as evidenced by the papers of Dr. W J McGee in the fourth volume of the Geological Society of America, Dr. G. C. Broadhead in the *American Geologist* in August, 1902, and Professor E. M. Shepard in January–February number of the *Journal of Geology* of the present year. In Broadhead's paper are given abstracts of a considerable number of contemporaneous and other early publications on the earthquake phenomena, but the description by Audubon seems to have been overlooked. As he was one of the few, quite possibly the only, scientist who was in the region at the time, his account is of interest. It is of significance that it agrees very closely with the descriptions of many of the residents, indicating that the accounts are probably not so distorted as has sometimes been thought. Audubon's description is in part as follows:*

Traveling through the Barrens of Kentucky * * * in the month of November [1812],† I was jogging on one afternoon, when I remarked a sudden and strange darkness rising from the western horizon. Accustomed to our heavy storms of thunder and rain I took no more notice of it, as I thought the speed of my horse might enable me to get under shelter of the roof of an acquaintance, who lived not far distant, before it should come up. I had proceeded about a mile, when I heard

* 'Audubon and his Journals,' Vol. II., pp. 234–237, Charles Scribner's Sons, New York, 1897.

† The first of the series of shocks was on December 16, 1811.

what I imagined to be the distant rumbling of a violent tornado, on which I spurred my steed, with a wish to gallop as fast as possible to a place of shelter; but it would not do, the animal knew better than I what was forthcoming, and instead of going faster, so nearly stopped that I remarked he placed one foot after another on the ground, with as much precaution as if walking on a smooth sheet of ice. I thought he had suddenly foundered, and, speaking to him, was on the point of dismounting and leading him, when he all of a sudden fell a-groaning piteously, hung his head, spread out his four legs as if to save himself from falling, and stood stock still, continuing to groan. I thought my horse was about to die, and would have sprung from his back had a minute more elapsed, but at that instant all the shrubs and trees began to move from their very roots, the ground rose and fell in successive furrows, like the ruffled waters of a lake, and I became bewildered in my ideas, as I too plainly discovered that all this awful commotion in nature was the result of an earthquake. * * * The fearful convulsion, however, lasted only a few minutes, and the heavens again brightened as quickly as they had become obscured; my horse brought his feet to their natural position, raised his head, and galloped off as if loose and frollicking without a rider. * * * Shock succeeded shock almost every day or night for several weeks, diminishing, however, so gradually as to dwindle away into mere vibrations of the earth. Strange to say, I for one became so accustomed to the feeling as rather to enjoy the fears manifested by others. * * * The earthquake produced more serious consequences in other places. Near New Madrid and for some distance on the Mississippi, the earth was rent asunder in several places, one or two islands sunk forever, and the inhabitants fled in dismay towards the eastern shore.

M. L. Fuller.

U. S. Geological Survey.

SUGGESTIONS FOR FACILITATING THE WORK OF ZOOLOGISTS.

Two plans have occurred to me which would, I think, considerably lighten the work of zoologists if they could be carried out. As they do not seem wholly impracticable, I venture to present them for consideration and discussion.

1. No generic name is allowed to be used twice in zoology; so that when any name is used a second time, by inadvertence, it falls as a homonym, and a substitute has to be proposed. As a matter of fact, the literature swarms with such homonyms, and we are constantly finding ourselves under the necessity of making changes because of them. Now that we have Scudder's 'Nomenclator' and Waterhouse's 'Index,' bringing the list of names proposed up to 1900, it ought to be quite possible to overhaul the whole series up to date, and make a list of *all* the homonyms known. If such a list were made in manuscript it might be divided into minor series according to the groups of animals, and each of these sent to a specialist in the group concerned. These specialists might then go carefully over the lists, seeking the advice and assistance of colleagues, and sift out all the names for which substitutes had already been proposed, and those which stood for invalid genera, leaving a residue of homonymous names for valid genera to be dealt with. This residue would have to be again examined to see whether any other names, hitherto placed in the synonymy, could be substituted, and when this could not be done new names should be proposed. This would involve a great deal of work, but it would get rid of the trouble from homonyms once for all, so far as the past is concerned; except, of course, those resulting from names overlooked in the indices. It would save us from the present sense of insecurity regarding names, and from a great deal of duplicated labor in looking up the names in use, lest they should be preoccupied. If the full list were published, it would also prevent the proposal of new substitutes for names which had already been suitably replaced on account of homonymy.

Such a work ought to be cooperative; because it could not be done well—even the first part, of matching names and detecting homonyms—by persons unfamiliar with scientific names; while it would not be reasonable to expect a working zoologist to devote his time to it to the exclusion of his original investigations. If each letter, in the first part of the work, were undertaken by one individual, it would not be long before it might be finished. For the later investigations, specialists would have to be allowed to take their own time; but the groups first done could be published, without waiting for the others. The publication of the lists would be rather expensive, and would have to be undertaken by some institution. Whether the work itself could be done by volunteers, I do not know; but if any money could be obtained in payment for it, it would probably be easier to find workers.

2. At present new species of animals are described in all sorts of publications, in consequence of which it often becomes expensive or difficult to obtain the descriptions relating to any one group. It might be a very good plan if all descriptions of new species and varieties of North American animals were published (or republished) in a single series, on leaflets somewhat like those issued by the Biological Society of Washington. It might be so arranged that each leaflet should include only a single species or variety, or perhaps only those of a single genus, and each might be sold at a stated price. One could then subscribe for all the new descriptions pertaining to a certain genus, family or order, and receive them immediately upon publication. They could be bound up, when numerous enough, in any way that proved convenient; *e. g.*, all the new animals from Colorado, or all the new mammals from North America. The descriptions should, of course, be published promptly, and strictly in the order of their receipt at the editorial office. All descriptions of reputable authors should be accepted, but it would be appropriate to make certain rules, applicable to all; thus it might be required that the descriptions should be reasonably complete, or not conspicuously incomplete; that the exact locality and collector's name should be given, if ascertainable; and that comparison should be made with allied species. The same plan would be equally applicable to plants, of course. A special series of leaflets, issued with the others, might be devoted to the proposal of synonymy, or of new combinations. How much financial support such a plan would require I do not know; perhaps it would pay for itself, or nearly. It would probably not be necessary to take any special steps to persuade authors to send their new descriptions for publication in the leaflets; the majority would doubtless soon do so as a matter of course, while those who did otherwise would find their descriptions reprinted in the regular series.

T. D. A. Cockerell.

Boulder, Colorado.

SPECIAL ARTICLES.

A CARD INDEX STOCK LIST FOR USE IN UNIVERSITY DEPARTMENTS OF ORGANIC CHEMISTRY.

One of the administrative difficulties confronting the head of a university department of organic chemistry is the proper listing of the great variety of chemicals carried in stock, and constantly accumulating year by year as the result of the various investigations conducted in the laboratory. The troubles of the organic chemist in this respect are much greater than those of his inorganic colleague, for he must carry in stock not only about all the chemicals required by the inorganic chemist, but his own innumerable organic chemicals as well. In the larger universities, this accumulation of stock in the departments of organic chemistry amounts to many thousand lots, generally distributed in various rooms—the general stock rooms and closets, the main laboratory, the research rooms, the rooms of the officers of the department, the chemical museum, and elsewhere; in all kinds of containers, large and small, boxes, crocks, bottles, specimen tubes, and the like. To classify and list this mass of scattered material in such a way that an instructor can tell in a few moments whether a certain chemical is available in the department, and if so, in what amount and quality, and, further, to keep such a list constantly up to date, in spite of daily removal of stock and addition of new material, is not a simple task, as I think most of my colleagues will admit. And yet, without such a list more or less confusion is likely to result, and much valuable time will be wasted in pawing over a lot of bottles or specimen tubes in a vain search for a compound which is not in stock at all or can not be found, or, in other cases, for substances which, when found, prove to be too impure or too small in amount to be of any use. In this country, the failure to keep accurate track of stock available is more serious in the case of organic compounds than of inorganic, for the latter can usually be secured here of satisfactory quality, but, with the exception of the very commonest, practically all fine organic chemicals must be imported from Germany. As it takes about two months for such importations, a serious delay may thus be caused in the prosecution of a research, the only escape from which is for the investigator to turn in and make the substance himself.

We have not found it necessary to index our inorganic stock, for this can be satisfactorily classified by keeping all the compounds of the same element together, and arranging the elements alphabetically on the shelves of the stock room. We have found it necessary, however, to index our organic stock, with the exception of the reagents on the laboratory shelves.

That an alphabetical classification of organic substances is not very satisfactory will, I think, be readily admitted by all organic chemists, particularly by those who have had occasion to search for compounds in Watts's Dictionary. No doubt every method of classification has its shortcomings and inconsistencies, but for purposes of indexing we have found the 'Beilstein' classification most satisfactory, for the reason that when in doubt we can always refer to this standard work, or to Richter's 'Lexikon,' which latter constitutes a complete general index to Beilstein. In order to record location of stock, our rooms are all numbered, and when necessary the shelves (from top to bottom), rows (from back to front) and individual bottles (from left to right) also. Thus '406, 16, 1, 10' would mean—room 406, shelf 16, row 1, bottle No. 10. It is not necessary often to elaborate quite so much as this—for increased elaboration means diminished freedom of arrangement on the shelves—but we have found it helpful in the case of deep shelves in dark corners, and it then becomes necessary to supplement the general index by a special shelf list, to prevent and correct any disarrangement of stock on the shelves.

The index is a card catalogue, composed of

Name, *p*-Amino Benzonitrile, II, 1273.

Formula, $C_7H_6N_2 = C_6H_4 \left\langle \begin{matrix} CN\ (1) \\ NH_2\ (4) \end{matrix} \right.$ = 

M. P., 86°.

B. P.

Amount.	Maker.	M. P.-B. P.	Location.	Cost.	Remarks.	Date.
10 gm.	L. Kohnstamm.	86°	Museum.		Reduction of nitro nitrile.	1902
0.7 "	"	"	408 N.		Engler's method; $Zn + HCl$.	"
1.0 "	"	"	"		$SnCl_2 + HCl$.	"
0.5 "	"	85.6	"		Fricke's method; $Sn + HA$.	"
0.2 "	Ferrero.	85–85.5	"		*p*-uramino benzoic acid $+ P_2O_5$	"
50 "	Williamson.	86	405		Reduction of nitro; c. p.	1903

5″ x 8″ cards. The Macey cards are by far the most convenient, as their side locking system permits the removal of any card, by a half turn of the locking rod, as rapidly as though the cards were not locked in at all. A sample card is shown herewith. These cards are arranged in drawers in the 'Beilstein' order, colored guide cards indicating the divisions of the classification. The numbers (II., 1273) in the upper right-hand corner indicate the volume and page of Beilstein's 'Handbuch' (third edition) where the compound will be found described in detail. This has the further advantage that when one does not remember off-hand in just which group a certain compound is classified, all that is necessary is to get the volume and page reference from Beilstein and it can then be found very quickly in the index. In other words, the paging (if it may so be termed) of the index is identical with that of Beilstein. The melting-points (M. P.) and boiling-points (B. P.) provided for in the upper right-hand corner are those recorded in the literature, while those in the column near the middle of the card represent the actual melting-points or boiling-points of the various samples listed; a comparison of the two will, therefore, indicate the probable purity of the different samples. It is obvious that such a card properly filled out will give the instructor at a glance all the information desired concerning his stock.

I think that I hear the reader saying to himself, 'All very pretty! but it must take an immense amount of time to get up such a list, and it would be perfectly hopeless to attempt to keep it up to date!' It is quite true that it does take some time to prepare such a list, particularly where the mass of material is great, but the time thus lost is very quickly made up by the time saved in the use of the index, and when once done it does not have to be done over again. I assume that every laboratory finds it desirable to take a complete account of stock at least once a year. As to the other objection—keeping such a list up to date, our method is as follows: Two sets of printed blanks are used, about 3″ x 5″, one printed on blue paper, the other on white. One is for stock removed, the other for new stock. On the blanks headed 'Removed' are the following items—substance, amount, maker, location, date, for; on the 'New Stock' blanks—substance, amount, maker, cost, location, date. Whenever any chemical is removed from stock for use in a research, to replenish a reagent bottle, or for whatever purpose, one of these 'Removed' blanks is filled out and put on file, and once a month or so these blanks are checked up and the index corrected accordingly. After correcting the index, the blanks are not destroyed, but are kept on permanent file, and at the close of the year an examination of the total blanks on file will show exactly how much and where the stock is most in need of replenishing, thereby furnishing the necessary information for the preparation of the annual import order. The 'New Stock' blanks should also be placed on permanent file after having been entered in the index. It will be found more convenient, in both cases, to use a separate blank for each separate bottle.

Such a general stock list is not only a perpetual inventory, but it may also do duty as a chemical museum catalogue, and be useful in other directions also. For example, it will show instantly any change in the market price of the chemicals listed, and perhaps thus lead occasionally to the correction of unintentional overcharges on the part of dealers. When once made, it requires only occasional attention, and the addition of new cards for new substances. Wherever possible, as in the chemical museum and general stock rooms, the stock should be arranged in the same order as in the index.

As the above method has appeared to interest so many of our brother chemists both here and abroad, I have taken this opportunity of making it available to all, in the hope that others may find in it something useful or suggestive. It has been in use in the department of organic chemistry of Columbia University for several years, and has been of very great assistance to us in our work.

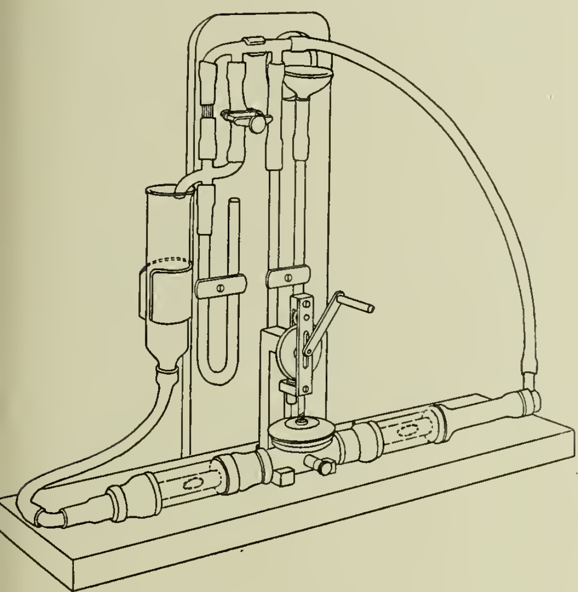
Marston Taylor Bogert.
Havemeyer Laboratories,
Columbia University,
March 30, 1905.

A QUANTITATIVE CIRCULATION SCHEME.

The artificial scheme (Fig. 1) to illustrate the mechanics of the circulation in the highest vertebrates consists of a pump, a system of elastic tubes and a peripheral resistance. The inlet and the outlet tubes of the pump are furnished with valves that permit a flow in one direction only. The peripheral resistance is the friction which the liquid undergoes in flowing through the minute channels of a piece of bamboo. To this must be added the slighter resistance due to friction in the rubber and glass tubes.

In this system the pump represents the left ventricle; the valves in the inlet and outlet tubes, the mitral and aortic valves, respectively; the resistance of the channels in the bamboo, the resistance of the small arteries and capillaries. The tubes between the pump and the resistance are the arteries; those on the distal side of the resistance are the veins. The side branch substitutes a wide channel for the narrow ones, and thus is equivalent to a dilatation of the vessels.

The pressure in the ventricle is varied through a tambour covered with rubber membrane. The membrane is grasped between two disks, one below and one above. The upper disk is screwed down upon the lower until the membrane is tightly held. To these disks is fastened a rod which ends in a yoke. The yoke rests upon a small wheel, which in turn is supported by a brass plate eccentric in form. This brass plate is revolved by turning a handle attached to the axle. As the plate revolves the small wheel bears upon the eccentric rim and rises and falls with the rise and fall in the rim of the plate. The motion of the small wheel is transferred through the yoke, rod and disk to the rubber membrane and thus to the interior of the ventricle.



The rim of the eccentric brass plate reproduces the intraventricular pressure curve in the dog. In projecting this curve upon the plate the periphery is divided into fractions of a second and the radii are divided into millimeters of mercury pressure.

Each revolution of the eccentric plate reproduces in the ventricular tube both the time and the pressure relations of the ventricular cycle in the dog. The intraventricular pressure curve may be written by connecting the side tube with a membrane manometer, and clamping off the arterial mercury manometer to be mentioned shortly.

When the pressure rises in the ventricle to a sufficient height the contents of the ventricle will be discharged through the aortic valve into the aorta, and thus (through a convenient metal tube) into the arterial tube, leading to the capillary resistance. Here two paths may be taken: the liquid may pass either through the capillary channels in the cane, thus meeting with a high resistance, or this resistance may be lessened to any desired degree by unscrewing a clamp and thus opening the side tube. Both paths lead to the venous tubes, whence the liquid passes through the mitral valve into the ventricle. The mitral and aortic valves are of a modified Williams type. Metal tubes closed at one end conduct the liquid respectively to or from the ventricle. The liquid enters or leaves the valve tube through a hole covered by a rubber valve-flap, not shown in Fig. 1. Each valve is surrounded by a glass tube through which the working of the valve may be inspected.

Mercury manometers measure the pressure in the arteries and veins near the capillary resistance. The arterial manometer is provided with a glass thistle-tube to catch any mercury that may be driven out by a careless operator.

If the arterial mercury manometer be replaced by a membrane manometer, or if it be provided with a float and writing-point arterial pressure curves may be written, identical with those obtained from the carotid artery of the dog.

Normal sphygmographic tracings may be obtained by using a sphygmograph on the aortic tube.

Palpation of the arterial tube will give a pulse the 'feel' of which can not be distinguished from that of the pulse in the normal subject; the pressure waves in the quantitative scheme and in the living animal are identical in respect of both time and pressure.

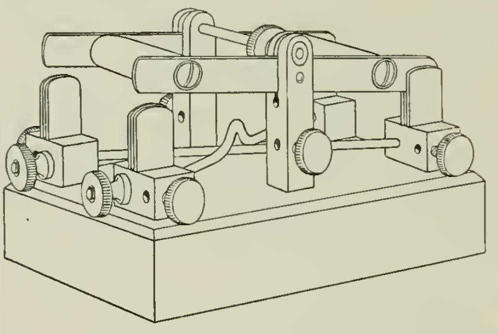
W. T. PORTER.

HARVARD MEDICAL SCHOOL.

ROCKING KEY WITH METAL CONTACTS.

THE instrument illustrated by the figure serves as a simple key, short-circuiting key, and pole changer. It is in fact a universal key. No mercury is used.

The central binding posts are prolonged upwards and each is slotted to receive a brass bar which is pivotted in the slot by a horizontal pin. The brass bars are held parallel by two rubber rods which serve as handles. When the bars are depressed to one side or the other, they engage between plates of spring brass set into brass blocks each of which carries a binding screw. Cross wires enter these blocks, as shown in the figure. At one end the cross wires are soldered into the blocks,



thus making an electrical contact. The two blocks at the other end are perforated by rubber cores or 'bushings' through which the cross wires pass. The cross wires, therefore, make no electrical contact with these blocks. When a contact is desired, the screw borne on the head of each cross wire is turned until its face presses against the brass block outside the bushing. In this position the key serves as a pole changer, commutator, or 'Wippe.'

A brass cross bar unites the central posts. At one end this cross bar does not make electrical contact with the post, but passes through a rubber bushing clearly shown in the figure. Contact is secured by turning a screw upon the cross bar until the face of the screw presses against the post outside the bushing. When this contact is made the instrument may be used as a short-circuiting key.

W. T. Porter.

Harvard Medical School.

SOME NOTES ON THE MYODOME OF THE FISH CRANIUM.

Myodome is a term given by Dr. Theo. Gill to the tube at the base of the cranium of fishes for the reception of the rectus muscles of the eye.

It is formed by an inner longitudinal wing springing from near the middle of the prootic, or near the center of the radiation of the structural fibers of the prootic, and meeting its opposite fellow separates the myodome from the brain cavity.

It has been variously called eye muscle tube, canal or vacuity, and Cope instead of considering the vacuity itself considered the walls forming it, thus: 'basis cranii double,' meaning a double floor to the cranium with a space (the myodome) between; 'basis cranii single,' or myodome absent. With the former term he often coupled the phrase, 'with a muscular tube,' meaning the vacuity was extended backwards in a tube in contradiction to its ending blindly.

The following matter was suggested to me by a few lines in an excellent paper recently published by Dr. W. G. Ridewood (*Proc. Zool. Soc. London,* 1904, Vol. II., p. 60) as follows:

> No value can be ascribed, so far as I can see, to a feature upon which Cope has laid some stress (*Trans. Amer. Phil. Soc.,* N. S., XIV., 1871), namely the double or simple nature of the basis cranii. This refers, so far as I understand his writings, to the separation of the parasphenoid from the prootic floor of the cranium by the eye muscle vacuity. The character is one which is very difficult of application; and it is a matter of individual opinion whether such a form as *Clupea* is to be regarded as having a simple or double bases cranii, for here the parasphenoid is produced backwards into a pair of large lateral wings, the space between them freely open below.

From the second sentence quoted, I should judge that Dr. Ridewood considers the myodome to be interposed between the floor of the cranium and the parasphenoid, rather than separated from the brain cavity. Or, in other words, that he considers the roof of the myodome to be the homologue of the cranial floor of forms having no myodome.

This does not seem to me to be the correct conception. That the floor of the myodome is the true cranial base and that the roof of it is simply a septum of secondary development would seem probable from the following evidence: (1) The lower edges of the prootics behave in exactly the same manner, whether or not the myodome is present. The prootics meet at the median line above the parasphenoid and form the floor of the brain cavity or myodome, as the case may be, or they end at the outer edges of the parasphenoid, the latter forming the floor. Perhaps, when the myodome is present the prootics meet in fewer cases than when it is not, but both conditions of the prootics are common with both conditions of the myodome. (2) In some forms when no myodome appears in the dried skeleton, if a fresh or alcoholic specimen be examined, a sheet of connective tissue may be found separating the eye muscles from the brain cavity. This tissue is attached to the prootics exactly as the bony shelf is, and possibly the ossification of the shelf takes place in it.

If this be so it explains why the myodome is of no more value in classification than it is, as there would be little difference between a connective tissue septum and the same tissue replaced by ossification. How great a proportion of the forms having no myodome have the connective tissue septum I do not know.

Looking at the matter in this light there seems little difficulty in my mind in deciding whether *Clupea* has a myodome. Any cavity between the prootic shelf and the lower symphysis of the prootics, or between the shelf and the parasphenoid, as the case may be, should be regarded as a myodome. I do not see the application of the fact that the parasphenoid is open below in *Clupea*. It is but a difference in degree between the forms where the myodome is open only posteriorly and where it is entirely open below. There are forms with the condition of the opening intermediate between these two extremes. Of course, the fact that the myodome is open below leaves only a single cranial base interpreted literally, but it could not be considered under the head of 'basis cranii single,' as it is the primary floor that is missing.

In examining a large number of fish specimens with these problems in view I also had for consideration two other problems in connection with the myodome, but unrelated to the above.

Vrolik* states that the prootic is not pierced by the facial and trigeminus nerves when the myodome is absent, in the forms he has investigated (*Gadus, Silurus* and *Lophius*). I can add my testimony as to the correctness of these conclusions so far as the forms quoted are concerned, but in the following forms, which have no myodome, the prootics are pierced by one or both the fifth and seventh nerves: *Tetraodon, Chilomycterus, Lycodes, Dormitator, Opsanus, Brosme,* and perhaps all of the family Blenniidæ (six genera were examined).

On the other hand, I know of no form having the myodome well developed, which has the prootics unpierced.

The second point I would touch upon is that the dichost (= basisphenoid of Huxley) is always absent when the myodome is. I know of no case where it is at all ossified when the myodome is absent, though there is often a connective tissue septum in this region continued forward as the interocular septum.

Nearly always the dichost is connected with the edge of the prootic shelf, or roof of the myodome, but that the shelf is not necessary to it is shown by *Esox,* where it is attached to the parasphenoid at its lower end and is free above. In this case the prootic shelf does not extend very far forward. This problem should be examined in connection with the connective tissue myodome septum as its ossification is probably of the same sort.

Edwin Chapin Starks.
Stanford University,
January 19, 1905.

BOTANICAL NOTES.

LIFE HISTORY OF THE PINES.

Last October Professor Dr. Margaret C. Ferguson, of Wellesley College, published in the 'Proceedings of the Washington Academy of Sciences' (Vol. VI., pp. 1–202) an important paper entitled 'Contributions to the Knowledge of the Life History of Pinus, with Special Reference to Spermogenesis, the Development of the Gametophytes and Fertiliza-

* Vrolik, 'Studien über die Verknocherung u. d. knochen des Schädels d. Teleostei,' *Niederland. Arch. f. Zool.*, Bd. 1., 1873.

tion.' She devotes a dozen or so pages to a brief historical sketch and several pages to the methods of collecting, fixing, sectioning and staining which she followed, and then takes up in successive chapters, 'Microsporogenesis,' 'The Male Gametophyte,' 'Macrosporogenesis,' 'The Female Gametophyte,' 'Fertilization and Related Phenomena.' In a short appendix the author has recorded a number of interesting and suggestive abnormal conditions which have been noticed by her and other observers. A full list of papers cited closes the text of this altogether admirable paper. The plates number twenty-four and include 275 well executed figures.

The work upon which the paper was based was begun in the fall of 1897. The discoveries of Hirase, Ikeno and Webber in the fertilization of the gymnosperms made it 'highly desirable that fertilization and the associated phenomena should be worked out for other members of this group by the more modern methods of investigation.' This was the task which Miss Ferguson set for herself, and in this paper she has recorded the results of her investigation of five species of pines (*Pinus strobus, P. rigida, P. austriaca, P. montana uncinata* and *P. resinosa*). Six hundred separate collections of material were made, and more than four thousand slides of serial sections prepared. This large number is necessary since in the pines a period of almost thirteen months elapses from pollination to the actual fertilization, during which many important cytological changes take place.

We have space to note here only a few things brought out in this paper: The author makes a distinction between the microspore (one-celled) and the pollen-grain (several-celled), the former developing into the latter by a series of divisions. In tracing the development of the sperm-nuclei (spermatozoids) Miss Ferguson finds what she suggests may be the vestigial state of the cilia-forming body found in the lower gymnosperms (*Cycas, Zamia* and *Ginkgo*). In the development of the macrospore the division of the mother cell is a true tetrad division, so that the macrospore is a true spore. This germinates and by a typic division gives rise to two nuclei which pass to opposite poles and there divide again and again until thirty-two or more free nuclei are formed before the long winter rest is entered upon. The prothallium is completed and the archegones (one to nine) are formed the next spring. In fertilization the sperm and egg-cell cytoplasms fuse, but the nuclei do not really fuse, but the chromosomes are mingled in the first mitosis.

LIMU.

This is the name applied to many species of seaweeds, especially those that are edible, by the native Hawaiians. In a recent number of the 'Publications' of the University of California (Vol. III., No. 3) Professor Dr. Setchell gives the results of the investigations made by him several years ago, with a view to determining the specific identity of the different kinds of limu. Altogether his list includes one hundred and seven names, not, however, representing that many distinct kinds. For many of these he has been able to determine the species used, while in other cases this has not been possible. One is surprised at the considerable number of species of seaweeds which the islanders have found to be edible, although one suspects that many of them would not be relished by us.

A NEW GRASS BOOK.

Although not strictly botanical the little book entitled 'Farm Grasses of the United States,' by Professor Spillman (Orange Judd Co.), is worthy of a brief notice in these columns. In it the author, who as is well known, is the chief of the Division of Agrostology of the United States Department of Agriculture, has brought together a good many facts that are of interest to the farmers of the country, and some also that will interest the general botanist. Thus the map on page 13 showing the relative amounts of wild, salt and marsh grasses annually cut for hay in different parts of the United States will interest every botanist, and so will the chapter on 'The Seed' (V.). So too the botanist will find something of interest in the succeeding chapters (VI. to XIII.) which discuss timothy, the blue-grasses, the millets, two southern grasses, red-top, orchard grass, brome grass, grasses of minor importance and those for special conditions. The book will be especially useful to farmers.

THE USEFUL PLANTS OF GUAM.

In a thick pamphlet of about four hundred pages issued by the United States National Herbarium ('Contrib.,' Vol. IX.) William E. Safford tells what is known as to the vegetation of the island of Guam, nearly 145 degrees east of Greenwich, and a little less than 14 degrees north of the equator. It is illustrated by 70 plates mostly from photographs, including one map of the island. It will be very useful to American botanists who wish to know more about the vegetation of this newly acquired territory, as well as those who wish to learn something as to tropical vegetation in general. The chapters relating to the geography, climate, animals and the people are also full of interest for the general reader, as well as the student of science.

Charles E. Bessey.

The University of Nebraska.

SCIENTIFIC NOTES AND NEWS.

Professor Charles S. Minot has been reelected president of the Boston Society of Natural History.

Dr. E. F. Nichols, professor of physics at Columbia University, has been awarded the Ernest Kempton Adams research fellowship, recently established at Columbia University by Mr. E. D. Adams in memory of his son. Professor Nichols has at present leave of absence and is working at Cambridge University.

About five hundred physicians of the United States and Canada were present at the dinner given in honor of Dr. William Osler, which was held in New York on May 2. The toastmaster was Dr. James Tyson, of Philadelphia, and the list of speakers and of the toasts to which they responded was: Dr. Osler in Montreal, 'Student and Teacher,' Dr. F. J. Shepherd, of Montreal; Dr. Osler in Philadelphia, 'Teacher and Clinician,' Dr. J. C. Wilson, Philadelphia; Dr. Osler in Baltimore, 'Teacher and Consultant,' Dr. W. H. Welch, of Baltimore; Dr. Osler, 'The Author and Physician,' Dr. A. Jacobi, of New York City; presentation of 'Cicero de Senectute,' by Dr. S. Weir Mitchell, of Philadelphia. To these speeches Dr. Osler replied.

The expedition to the Delta of the Colorado river and the Cucopa mountains organized by Dr. D. T. MacDougal, of the New York Botanical Garden, and Mr. E. A. Goldman, of the U. S. Biological Survey, has returned. The river was found in flood, the water reaching the highest level since 1891 and overflowing through various channels into the Salton Basin. Some important geographical details were brought to light and material additions were made to the knowledge of the natural history of the entire region, part of which had never before been visited by collectors.

The Alexandre de la Roquette gold medal of the French Geographical Society has been awarded to Professor Erich von Drygalski.

The Société de Topographie de France has awarded a medal to Dr. William Hunter Workman for topographical research among the high peaks and glaciers of the Himalayas.

Professor Léon Labbé, the eminent French surgeon, has been presented by his former students with a medal struck in his honor by Patey.

The Senckenberg Scientific Society of Frankfort has awarded its Sömmering prize for the most valuable work of a German investigator in physiology during the last four years to Professor Haberlandt, of Graz, for a work on 'The Sense Organs of Plants for the Perception of Mechanical Stimuli.'

At the annual meeting of the Boston Society of Natural History, on May 3, the first Walker prize, of $75, was given to Dr. W. B. McCallum, department of botany, University of Chicago; the second, of $50, to Mr. M. L. Fuller, United States Geological Survey, Washington, D. C. Their respective papers were 'Physiological Analysis of the Phenomena of Regeneration of Plants' and 'Quaternary Correlations around New York and on the Long Island Shore.'

Professor Lancereau, of Paris, has been elected president of the International Society for Combating Tuberculosis.

Professor C. H. Wind, having been appointed to a professorship in the University of Utrecht, has resigned the directorship of the Dutch Meteorological Institute, and Dr. E. van Everdingen has been appointed provisional director.

Dr. Herman V. Hilprecht, professor of Assyriology at the University of Pennsylvania, sailed for Germany on May 2.

A testimonial banquet and special exercises will be held, May 18, by the alumni of the St. Louis College of Pharmacy in recognition of Professor James M. Good's having completed his thirtieth year as a member of the faculty of that institution. He was also dean of the faculty from 1878 to 1903 inclusive.

Dr. William H. Dalrymple, M.R.C.V.S. (Eng.), of the department of veterinary medicine in the Louisiana State University, has been elected to membership in the Royal Institute of Public Health, London.

Mr. William Henry Pulsifer, a manufacturing chemist, who was elected a fellow of the American Association for the Advancement of Science in 1879, has died at the age of seventy-four years.

We regret also to record the deaths of M. Henri de Saussure, the zoologist, at the age of seventy-six years; of Dr. Julius Nessler, the agricultural chemist of Karlsruhe, at the age of seventy-seven years, and of Dr. Paul Behrens, professor of technical chemistry in the Technical Institute at Danzig.

There will be a civil service examination on June 14 to fill vacancies in the position of scientific assistant in the Department of Agriculture, at salaries of from $840 to $1,200 a year, depending on qualifications and experience.

The thirty-second general meeting of the American Chemical Society will be held in the rooms of the Buffalo Society of Natural Sciences, Buffalo, N. Y., June 22–24, 1905. The preparation of the program for the meeting is in the hands of a committee consisting of Victor Lenher, for the section of inorganic chemistry; Marston T. Bogert, for the section of organic chemistry; W. R. Whitney, for the section of physical chemistry; John H. Long, for the section of sanitary, agricultural and biological chemistry, and Francis A. J. Fitzgerald, for the section of industrial chemistry. Mr. Fitzgerald will give an address on Friday evening, June 22, upon the subject of 'Electrochemical Industries at Niagara Falls.' Excursions to industrial establishments in Buffalo will be arranged for Friday afternoon and an excursion to Niagara Falls is arranged for Saturday. There will be the usual subscription dinner at the Hotel Iroquois on Friday evening.

The annual *soirée* of the Selborne Society was held on May 3. Lord Avebury was expected to preside, and a large number of archeological and natural history exhibits were planned.

The French government has granted a subvention of $20,000 in aid of the International Congress on Tuberculosis, which is to be held in Paris in October, 1905.

Articles of incorporation have been filed at Albany by the Bausch, Lomb, Saegmuller Company, the object of the new corporation as set forth in the papers being the manufacture of engineering, astronomical, physical and other instruments of precision. The manufacturing plant of the company will be at Rochester, N. Y., in the north end of the new addition to the Bausch & Lomb factory, and the Bausch & Lomb Optical Company, at Rochester, N. Y., will be the sales' agents of the new company. Mr. George N. Saegmuller will transfer his establishment from Washington to Rochester. He is well known for the important scientific instruments that have come from his shops, including the telescopes of the Chamberlain, Georgetown, Manila and other observatories, and other astronomical and optical instruments. It is said to be the intention to establish a scientific bureau for computation and research on the lines of the Carl Zeiss works of Jena, the results to be available both to the Bausch & Lomb Optical Company and the Bausch, Lomb, Saegmuller Company.

SENATOR WM. A. CLARK, of Montana, has contributed to the University of Montana Biological Station a sum sufficient to defray the expenses of an expedition among the unknown mountains of Montana. The expedition will be under the direction of Professor M. J. Elrod, and will visit the high mountain on whose summit is the United States Geological Survey monument. Several unexplored glaciers lie high up on the mountain. Later the party will visit other summits in the drainage of the South Fork of Flathead River. T. A. Bonser, of the Spokane High School, will look after the botany on the expedition. Later the party will return to Flathead Lake to take up the work of the University of Montana Biological Station. The expedition will start about June 20, and the return to Flathead Lake will be about the middle of July.

WILLIAM S. CHAMP has sailed for Liverpool to head a relief expedition on the ship *Terra Nova,* which is awaiting him in London. Mr. Champ's instructions from Mr. Ziegler are said to be to remain in the north until he has found Captain Fiala or his party. Mr. Champ is accompanied by Dr. Oliver L. Fassig, of Johns Hopkins University, a geographer, who will sail on an independent expedition on the *Belgica* to the east coast of Greenland, where, at Shannon Island, caches of food will be established for Captain Fiala, in the belief that he may return from the Arctic by that route. The expeditions will start about June 1.

THE New Zealand legislature passed in 1903 a law under which the metric system of weights and measures might be adopted at any time subsequent to January 1, 1906. The government has now announced its intention of adopting the system after an interval of twelve months.

AT the annual meeting of the Zoological Society of London, on April 28, the report was presented by the secretary, who stated that the number of fellows was greater than at any time in the history of the society. There was an increase of 48,866 in the number of visitors at the gardens, the total being 706,074, as against 657,208 in 1903. The cost of feeding the stock at the gardens was £3,423 4s. 5d., against £4,858 2s. in 1902. The total number of vertebrate animals in the menagerie was 2,552—640 mammals, 1,448 birds, 343 reptiles and amphibia and 121 fish.

ACCORDING to *Terrestrial Magnetism and Atmospheric Electricity* there will be a meeting of the International Committee on Terrestrial Magnetism and Atmospheric Electricity at Innsbruck during the meeting of the International Meteorological Congress. The opening meeting will be on September 9, the special meetings of the committee will probably be deferred, however, for a few days, in order to give ample time for those magneticians and electricians to attend who will participate in the eclipse observations of August 30. It is very much hoped that there will be a full attendance of investigators in terrestrial magnetism and atmospheric electricity.

THE same journal states that in the future the Kew magnetic observatory work is to be carried on at Eskdalemuir, Scotland. The site is in the valley of the Esk, towards the north of Dumfriesshire, one of the southern counties of Scotland. Being over fifteen miles from the nearest railway and in a rather inaccessible position, the probability of future disturbance is small. In addition to the magnetographs, the equipment, which is not yet fully decided upon, will consist of self-recording instruments for at least atmospheric electricity and earth tremors. In addition to the variometer building two absolute observation huts are being erected. The standardizations of magnetic instruments will be continued as heretofore, at the Kew Observatory, Richmond.

WE learn from *The Observatory* that Professor H. H. Turner, Savilian professor of astronomy at Oxford, gave a series of three afternoon lectures at the Royal Institution on March 2, 9 and 16. The series was entitled 'Recent Astronomical Progress,' and in the first the lecturer, dealing with solar matters, explained recent developments of the sun and earth-magnetism question, and described the new observatory on Mount Wilson, California, and its proposed work. The second lecture was devoted to an explanation of the lunar theory. On March 16 he spent some time in giving an account of the work at some American observatories and in showing photographs of nebulæ.

UNIVERSITY AND EDUCATIONAL NEWS.

It was announced at the meeting of the trustees of Columbia University, on May 1, that $500,000 had been given by an anonymous donor for the construction of a new college hall. Ground has already been broken for the new building in accordance with plans prepared by Messrs. McKim, Mead and White, the architects of the university. It will stand at the southeast corner of Amsterdam Avenue and 116th St., adjoining the dormitories now in course of erection. The building will be known as Hamilton Hall, in honor of Alexander Hamilton of the class of 1777, and will thus perpetuate the name of the college building before the removal of Columbia University to its new site.

The legislature of Minnesota which has just adjourned, made direct appropriations for the University of Minnesota for the next two years amounting to $706,600, besides $58,000, derived from the insurance on the old main building, destroyed by fire last September. The largest items covered by the appropriation are $408,000 for a new main building, and $60,000 per year to the current expense fund. Besides money received by direct appropriation from the legislature, the university has a regular annual income of $438,000, derived from the tax levy, invested funds and other sources.

Ground has been broken for the new building for the College of Agriculture at Cornell University. It is expected that the buildings will be completed in the summer of 1906 at a cost of $250,000.

Professor Alpheus S. Packard bequeathed about 2,000 scientific books to Bowdoin College. He also bequeathed $200 to the college to be reinvested until it shall amount to $2,000, when it shall be called the Packard Scholarship, in memory of his father, Professor A. S. Packard, class of 1816. The interest is to be used for the aid of students in botany, zoology and geology.

A professorship of civil engineering in the University of Birmingham with a salary of £600 has been established. The professor will be allowed to take higher consultative work, to keep in touch with civil engineering practise, provided that it does not interfere with his university duties. Applications, accompanied by 75 copies of testimonials, should be received by the secretary not later than May 20.

At the University of Nebraska departments of pathology and bacteriology, of applied mechanics and machine design, and of geography have been created. Dr. R. H. Wolcott has been promoted to a professorship of anatomy; G. R. Chatburn to an associate professorship of applied mechanics and machine design; G. E. Condra to an associate professorship of geography and economic geology, and Herbert A. Waite to an associate professorship of pathology and bacteriology.

Dr. Ralph Garrigue Wright, B.S. (Columbia, 1899), Ph.D. (Basel, 1902), who has been acting as Professor Bogert's private assistant in connection with some investigations in organic chemistry at Columbia University this year, has been called to the professorship of chemistry at Washington and Jefferson College.

Mr. D. A. Lyon, instructor in geology and mining in Stanford University, has been promoted to an assistant professorship.

Messrs. O. A. Molatch and W. M. Kelsie have been appointed assistants in chemistry in Cornell University.

Mr. Charles F. McKim, of Messrs. McKim, Mead and White, and Mr. Thomas Hastings, of Messrs. Carrere and Hastings, have been appointed directors of ateliers, with the rank of professor in the School of Architecture of Columbia University.

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FRIDAY, MAY 19, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

SCIENTIFIC SURVEYS OF THE PHILIPPINE ISLANDS.

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES.

To the Senate and House of Representatives:

Circumstances have placed under the control of this government the Philippine Archipelago. The islands of that group present as many interesting and novel questions with respect to their ethnology, their fauna and flora, and their geology and mineral resources as any region in the world. At my request, the National Academy of Sciences appointed a committee to consider and report upon the desirability of instituting scientific explorations of the Philippine Islands. The report of this committee, together with the report of the Board of Scientific Surveys of the Philippine Islands, including draft of a bill providing for surveys of the Philippine Islands, which board was appointed by me, after receiving the report of the committee appointed by the National Academy of Sciences, with instructions to prepare such estimates and make such suggestions as might appear to it pertinent in the circumstances, accompanies this message.

The scientific surveys which should be undertaken go far beyond any surveys or explorations which the government of the Philippine Islands, however completely self-supporting, could be expected to make. The surveys, while of course beneficial to the people of the Philippine Islands, should be undertaken as a national work for the information not merely of the people of the

Philippine Islands, but of the people of this country and of the world. Only preliminary explorations have yet been made in the archipelago, and it should be a matter of pride to the government of the United States fully to investigate and to describe the entire region. So far as may be convenient and practical, the work of this survey should be conducted in harmony with that of the proper bureaus of the government of the Philippines, but it should not be under the control of the authorities in the Philippine Islands, for it should be undertaken as a national work and subject to a board to be appointed by Congress or the President. The plan transmitted recommends simultaneous surveys in different branches of research, organized on a cooperative system. This would tend to completeness, avoid duplication, and render the work more economical than if the exploration were undertaken piecemeal. No such organized surveys have ever yet been attempted anywhere, but the idea is in harmony with modern scientific and industrial methods.

I recommend, therefore, that provision be made for the appointment of a board of surveys to superintend the national surveys and explorations to be made in the Philippine Islands, and that appropriation be made from time to time to meet the necessary expenses of such investigation. It is not probable that the survey would be completed in a less period that that of eight or ten years, but it is well that it should be begun in the near future. The Philippine Commission and those responsible for the Philippine government are properly anxious that this survey should not be considered as an expense of that government, but should be carried on and treated as a national duty in the interests of science.

Theodore Roosevelt.

The White House,
February 7, 1905.

REPORT OF THE COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES.

1. *Need for Comprehensive Work.*—The primary incentive to scientific exploration of the Philippine Islands, as of any other region, is a desire to promote the commercial and industrial welfare of the inhabitants, and this purpose should never be lost sight of. Experience shows that this end is best attained by a comprehensive investigation of facts and conditions undertaken in a broadly scientific spirit. Millions of dollars have been spent in searching for coal in regions where the rocks are far older than the coal measures; it was the seemingly unpractical science of paleontology which put a stop to this waste and enabled geologists to outline the areas to which valuable coal fields are limited. So, too, antiseptic surgery is an application of recondite branches of botany and chemistry. The vast benefits which the Agricultural Department and the Fish Commission have conferred upon our country are founded upon the untiring labors of zoologists, botanists and chemists whose sole purpose was to elucidate the truth; and long after Franklin took the first step in the science of electricity economic applications of the knowledge acquired were almost undreamed of. In short, modern industrial development is an outgrowth of pure science, and almost every discovery of science is ultimately turned to economic account. Hence it would be short-sighted not to extend to the Philippines the broad and generous spirit of research which animates the governmental scientific work of the United States.

The main object to be sought in planning explorations of the Philippines is not to suggest new or unusual subjects of study or methods of study, but to provide against duplication of work, and to arrange for such cooperation between the officers engaged in different branches of the Scientific Surveys as will insure rapid, satisfactory and economical progress in a noble contribution to human knowledge.

Since the United States is engaged in the first serious attempt to develop an Anglo-Saxon civilization in the tropics, and among a non-Aryan people, it may not be amiss to call attention to the effect on the enlightenment and culture of the Filipinos which systematically undertaken scientific surveys must inevitably produce. Such explorations will be a practical lesson in the application and value of learning.

2. *Resources of the Islands.*—The Philippine Islands form an extreme portion of one of the most interesting areas in the world, viz., Malaysia. The archipelago lies along the edge of the great and permanent abyss of the Pacific Ocean, forming the last bulwark of the Asiatic continent towards the southeast. This geographical position, half-way between Japan and Australia, with the China Sea on one side and the Pacific on the other, is most favorable to the development of a great commerce, which, indeed, the Philippine Islands once enjoyed.

The archipelago has not always been separated from Borneo, Java, Sumatra and the Peninsula of Malacca; on the contrary, land connections throughout this area existed at various times in its geological history. It is also probable that at one time Luzon and Formosa were connected. The islands themselves have undergone many geological vicissitudes, still indicated in part by the belts of extinct and active volcanoes which intersect them.

Gold veins, seemingly of very ancient origin, are widely distributed in the islands, though no great gold field is known to exist there; and there are some valuable copper deposits. The Philippines contain also important deposits of mineral fuel similar to the so-called coals of Japan and Borneo—a good quality of lignite—upon which much of the industrial development of the islands must depend. It is well known that the fertility of the Philippines is astonishingly great. This is due primarily to a favorable admixture of various igneous rocks with limestones and sandstones. In the moist and equable climate of the archipelago the rocks are rapidly converted into soil, while the absence of cold and drought results in a vigorous growth of roots, which protects the soil, as soon as formed, from rapid erosion by the heavy rains. One evidence of the fertility of the land is the presence of superb hardwood forests. These have been estimated to cover at least a third of the area of the islands, or, say, forty thousand square miles, and they include nearly two hundred species of valuable timber trees. All tropical crops will grow in the Philippines, while that very important plant (*Musa textilis*) which yields the so-called manila hemp, flourishes best in the archipelago. The resources of the islands have been very imperfectly developed; indeed, under Spanish rule, attempts at industrial progress usually met with disfavor. After the establishment of a well-ordered peace, the first step in progress must be the accumulation and dissemination of accurate and systematic information.

3. *Need of Coordination.*—In order rapidly and economically to provide the information desired, it is essential that the various branches of the work should be coordinated, for they are to a considerable extent interdependent; for example, topographical maps, which are an indispensable preliminary to geological mapping, are also required for planning highways, for military purposes, for the Land Office, for the Bureau of Forestry and for other ends.

It will be necessary in the Philippines, as elsewhere, to map some regions on a larger scale than others. Simple relations between the several scales used should be maintained, as is done in the topographical mapping of the United States. In selecting the scale for any region the uses to which the map is to be put should be well considered and the survey made with an amount of detail adequate to the use in view. A naval station, an army post, or the location of a possible canal should be surveyed in greater detail than would elsewhere suffice. It seems entirely practicable to foresee the probable development of a system of highways, since these are largely controlled by natural conditions, and there is no reason why the development of means of communication should not be taken into consideration in the original surveys. The mapping of each area should thus be undertaken on such a scale as will suffice for the several purposes to which the government expects to apply the maps. Similarly, geological work should be done not merely with a view to elucidating the physical and biological history of the archipelago, or even to describing the mineral resources of the islands; the origin of soils, the occurrence of road metal and the facilities for or the obstacles to the cutting of canals, tunnels, or roads should be systematically reported upon from a geological point of view. Indeed it is manifest that assistance can and should be rendered by each branch of a complete survey to one or more coordinate branches. For this reason a plan of cooperation will be suggested somewhat later.

4. *Scope of Inquiry.*—The subjects which it is advisable for the government to investigate in the Philippines may be grouped as follows:

Coast and geodetic work and marine hydrography.
Land topography, including surveys and classification of the public land.
Geology and mineral resources.
Botany.
Problems of forestry.
Zoology.
Anthropology.

All of these subjects may be embraced under the general term scientific explorations, and their study may be carried to a satisfactory degree of completion in a few years.

Several other lines of inquiry are omitted from the enumeration, although they also are of great importance in the economic development of the islands. They are chiefly of local interest, and are largely administrative, but are permanent in character. They include meteorology, sanitation, the study of animal parasites, insect pests and the fungous diseases of plants, as well as sylvicultural and administrative forestry and the establishment of agricultural experiment stations and of zoological and botanical gardens. These lines of investigation have already been initiated and more or less fully provided for by the civil government of the Philippine Islands. The scientific surveys would naturally cooperate as far as possible with the insular scientific bureaus to the great advantage of both.

These several branches of the inquiry will furnish contributions to human knowledge, the importance of which will probably stand in the following order: Zoology, anthropology, botany, forestry, geology.

5. *Coast and Geodetic Work.*—The first step to be taken in the survey of the Philippines is the establishment of geographical stations and a primary triangulation. The position of Manila Observatory is of course well known, and many other points have doubtless been well determined, but the accuracy of existing determinations should be checked and the network completed. The land area of the archipelago is not large—only about 120,000 square miles—but because of its distribution in several hundred islands the area to be triangulated is far larger.

The importance of marine hydrography requires no emphasis further than to recall the accidents and disasters which have occurred in the Philippine Islands since the American occupation for lack of adequate surveys and charts. It seems eminently desirable that, as fast as the triangulation is sufficiently advanced, a survey should be made of the very extensive shore line of the archipelago by a corps of marine hydrographers. These can determine better than topographers the amount of detail desirable in the line common to land and marine surveys. The line so determined should be accepted by both corps, and from it the hydrographers should work seaward and the topographers inland. The hydrographers will meet with especial difficulties on account of the innumerable coral reefs in the Philippine waters, and may also have trouble with recent uplifts, such as are alleged to have taken place within a few years in the Island of Paragua. There and elsewhere bench-marks should be established.

The Coast and Geodetic Survey has already begun work in the Philippines. It has occupied twenty-eight well-distributed astronomical stations, all in telegraphic communication with Manila, commenced a considerable number of harbor surveys, and initiated tidal observations at numerous points. It has also planned more extensive operations.

6. *Topography.*—Topographic work in the mountainous and wooded portions of the Philippines will be extremely difficult, the vegetation being so dense as to form an almost complete obstacle to vision and to free locomotion. However, in various portions of the archipelago, extensive open plains exist which can be rapidly mapped. It will probably be found that the native Filipinos will readily adapt themselves to topographical work, and, as they are extraordinarily agile, they will be of great assistance in the mountains and the forests. It is in the highest degree desirable that the surveys and subdivisions of the public lands should be committed to a topographical corps, such as that of the Geological Survey, as has been done, for example, in the Indian Territory. The topographical maps should show forest areas, but the discrimination of agricultural and mineral lands is not contemplated. As has been already noted, the scales employed should answer to the prospective uses to which the topographical maps are to be applied.

7. *Geology.*—The geological problems to be solved are numerous. The economic question of greatest moment is the stratigraphy of the coal-bearing Eocene formation, which is most extensively developed in southeastern Luzon (Albay and Sorsogon) and the Island of Cebu. It is probable, but not certain, that the coal deposits of Mindanao belong to the same period. The Eocene has been much disturbed and considerably faulted, so that its study will be a somewhat serious task. The coral reefs, volcanoes and earthquakes will necessarily also demand the attention of geologists.

The dense vegetation of the tropics offers great obstacles to the study of geology, and in the Philippines the lack of roads will also delay the work. There is, however, one set of exposures which are admirable and of vast extent, as well as readily accessible by proper means. It has been estimated that there are over eleven thousand miles of seacoast, without counting minor indentations, and along most of this line the rocks are exposed by wave action. The study of the geology of the country will probably proceed most rapidly if begun from boats along these coasts, and in beginning geological work on any of the smaller islands it will probably be expedient, as well as most economical, first to circumnavigate the island in steam-launches, mapping the exposures with care. With the information thus obtained it will be comparatively easy to extend the surveys into the interior.

The geological formations of the East Indies, including Malaysia, are as yet imperfectly correlated with those of Europe. The distance separating these two regions is so great, and the intervening land mass with its peculiar mountain systems is so immense, as easily to account for extreme differences in fossil remains, rendering it difficult to correlate the two systems. On the other hand, in America, where the mountains and coasts have a southerly trend, formations can be followed from the temperate zone into the tropics with no great difficulty, and a definite correlation has thus been obtained. Hence it is advisable that the geologists, and especially the paleontologists, who may be sent to the Philippines, should have familiarized themselves with the geology of the marine strata of the West Indies and the Gulf of Mexico. In some respects knowledge of the geology of the tropics is of more importance in the elucidation of the earth's history than that of the temperate zone. Climatic conditions along the equator must always have been more equable than in the temperate zone, and the development of life must have been less affected by changes in local conditions. Hence near the equator, if anywhere, will be found evidence of variations in the climate of the earth as a whole in earlier geological times, variations such as may have been due to changes in solar emanation or in the composition of the earth's atmosphere.

Attention has already been called to the fact that geologists should systematically lend assistance in the study of soils and in the development of a system of highways.

8. *Zoology and Botany.*—The Philippines have long been an attractive field for the student of natural history, and some of the most important theories respecting the origin, distribution and coloration of animals and plants have resulted from studies in this region. It was chiefly from observations of the insects of the archipelago that Wallace discovered the law of natural selection independently of Darwin, who had not then published his 'Origin of Species.' But the fauna and flora are still very imperfectly known. Field work in ornithology has been more thorough than in the other lines; nevertheless, several of the larger islands have been only slightly explored, and some of the smaller ones not at all. A small collection of mammals made by a bird collector on Mount Data, in northern Luzon, comprising only such species as were brought to him alive by the natives, contained half a dozen new generic groups. This may be taken as a promise of what will be learned when the numerous lofty mountains of the larger islands are systematically explored. Heretofore most of the natural-history work has been along the coast and larger rivers. In future the most promising and important field, and also the most difficult so far as land species are concerned, is in the highlands of the interior.

The fauna of the Philippines is complex in origin and heterogeneous in character. It consists of types originally derived in part from the south (Borneo, Celebes and the Moluccas) and in part from the north (Formosa and southeastern China); hence it is not surprising that the animals and plants of certain islands differ widely from those of other islands. It is important that the fauna and flora of each island be studied in detail, and that the zoological work include mammals, birds, reptiles, batrachians, fishes, insects and marine invertebrates; and that the botanical work include, besides systematic botany, the study and identification of the food plants, fiber plants and medicinal plants used by the native tribes.

In each of these departments the work

should be under a trained naturalist, competent to supervise the field work, make the necessary technical studies and prepare the report relating to his own special line. The chief object of the work should be a complete and authoritative report on the fauna and flora of the islands, comprising descriptions of all the species, with a statement of their geographical ranges. This will lead to a natural classification of the islands according to the origin of the faunas and their relationship to one another and to those of adjacent islands. Attempts thus to group the islands have been made by Wallace, Steere, Worcester and others, but as yet the faunas and floras are too little known to admit of final judgment.

9. *Forestry.*—The subject of forestry in the Philippines is one which is both of deep scientific interest and of great importance in the economic development of the islands. A local bureau of forestry has already been instituted by the Philippine Commission, and this will undoubtedly be a permanent organization. It will be needed to protect, control and foster the extremely valuable timber resources of the islands, and it is already doing good work. There are, however, certain fundamental facts and relations in connection with the forests which can be ascertained only by a thorough scientific investigation, which is beyond the scope of the local bureau. These studies can be completed within a few years, with the certainty that the knowledge obtained will be of lasting benefit to the local bureau of forestry; and the investigation of these subjects properly belongs to a scientific survey of the archipelago. Such subjects are the sylvicultural organization of the forests; periodicity of growth in tropical trees; processes of seed-bearing, seed-distribution and germination; growth and competition in early life; the influence of moisture and temperature on the tropical forest and the influence of the forest on moisture and temperature. While forestry is, strictly speaking, a branch of botany, its methods are peculiar and it will be expedient to treat it as a separate branch of the scientific surveys.

10. *Anthropology.*—Although little is known of the archeology and ethnology of the Philippines, there are sufficient reasons for believing that, in these two closely related lines of research, facts of the greatest importance will be discovered in the archipelago. Indeed it is probable that in southeastern Asia or in the adjacent insular regions the remains of fossil man will be found. The discovery of bones of *Pithecanthropus erectus,* that strange ape-like man or man-like ape, in the Pliocene formation of the Island of Java, leads to the expectation that systematic research in the deposits marking the beginning of the Quaternary period in the Philippines will yield the remains and probably the works of man, and thus throw light on the subject of early man in Asia. The small amount of archeological research thus far accomplished in the islands has already revealed evidence of an apparently aboriginal people differing from the Negritos.

This Negrito race of the islands, with its closest affinities on the Malay Peninsula and the Andaman Islands, offers a problem of exceeding interest and scientific importance. Where did this Negrito race originate? Is it a distinct primitive type that has persisted in the outlying regions of the Asiatic continent? or is it a differentiated branch of a widely extended primitive race or species of man? These and other important questions may not improbably be answered by an extended anthropological survey of the Philippines.

Linguistic studies of the widest scope should be pursued on the islands. The myths and folk-lore of the various tribes should receive the attention now demanded by the requirements of science. Collections of archeological material also should be secured as a means of studying the early status of man on the islands; and the effect that the later intrusions have had on the aboriginal peoples ought to be ascertained by a thorough study of the customs, arts and mental characteristics of the many and diversified tribes.

Knowledge of these matters is essential in order that the proper method of dealing with the natives may be determined. The honor of the United States demands that every means be taken to avoid mistakes of ignorance in dealing with the vast and relatively helpless population of these islands. This first attempt of the United States to bring alien races of the tropics into the fold of Anglo-Saxon civilization should be guided by strictly scientific data and principles. This necessitates, first, thorough knowledge of the peoples to be assisted, and then measures which accord with their various customs and their capabilities. Only a thoroughly scientific anthropological survey can provide the information required for the attainment of enlightenment and humane results.

11. *Collections and Their Disposition.*—Each special survey should cooperate as far as practicable with other branches of the service in the collection of specimens, and be ready to afford them all facilities not incompatible with its own efficiency.

The specimens collected will be the property of the United States. The first series, including all type specimens, should be deposited in the United States National Museum. A series of duplicates should be deposited in a local museum in the Philippines, such museum to be designated by the Philippine Commission. Other duplicates, if there be any, should be distributed to such leading museums, desiring collections of this character, as by reason of permanent endowments are able properly to care for and preserve the specimens.

12. *Comparative Studies in Adjacent Islands.*—For the purposes of the contemplated surveys Malaysia as a whole constitutes a convenient geological and biological province. A very large amount of valuable scientific investigation has been accomplished in other portions of Malaysia, particularly by Dutch geologists and naturalists. Some of the questions arising in the Philippines can not be satisfactorily settled without comparison of the occurrences in the archipelago with those in adjacent islands. Hence this committee is of opinion that general permission should be granted to the scientific surveys of the Philippine Islands to send observers, from time to time and for brief periods, to neighboring islands for the purpose of making comparative studies. Great saving of time and great increase in efficiency would result from such a provision.

13. *Administration.*—The scientific history of the United States during the last fifty years demonstrates the value of unification and systematic organization in such surveys as are contemplated in this report. The state geological surveys were manned by able and industrious observers, but there was a lack of unity of method and a lack of unity of aim, which made it nearly impossible to correlate their results. No one familiar with the subject will question the statement that the country as well as the science of geology has profited by the extension of the United States Geological Survey over the entire country. The national scientific bureaus have, laboriously and after long experience, developed methods of work and staffs of assistants which are at least equal to any in the world. To develop in the Philippines a separate set of similar bureaus would require much time and loss of time. Nor would employment in such bureaus be attractive; for prolonged service in the tropics is so trying to most constitutions that the number of

competent men willing to accept permanent positions there will probably not exceed the demand of the insular administrative bureaus to which reference has been made in a preceding paragraph. On the other hand, there seems no essential difficulty in embracing this area, like any other territory of the United States, in the fields occupied by existing national bureaus. Members of these organizations would be willing to be detailed for two or three years to so interesting a region as the Philippine Islands, with the prospect of resuming duty at home.

In order to secure cooperation and to preserve due proportions between the various surveys under the charge of the national bureaus, to arrange for suitable forms of publication of reports, prepare estimates, recommend legislation, determine upon the system of measurements, and to settle other questions of common interest, there must be frequent consultations in Washington between the representatives of the various branches of the work. For this purpose it is suggested that a board of Philippine surveys be created and put in charge of the work. It is manifestly of the utmost importance that such a board should be composed exclusively of eminent scientific experts, who alone are competent to direct the work. For administrative reasons it is essential that the board should consist of officers selected from the national scientific bureaus, and in the opinion of the committee these should be:

Superintendent of United States Coast and Geodetic Survey.

Director of United States Geological Survey.

Chief of United States Biological Survey.

Botanist of United States Department of Agriculture.

Chief of Bureau of Forestry.

Chief of Scientific Staff of Fish Commission.

Chief of Bureau of American Ethnology.

From these members one should be appointed chairman by the President, with the consent of the Senate, and the chairman should report to the President. There are precedents for such an organization in the Smithsonian Institution and in the boards of commissioners appointed to represent the government at various expositions.

The chief necessary expense of such a board would be a very moderate sum for clerical assistance; but it would probably be expedient and economical for the board to employ an officer, to be stationed at Manila, to perform functions analogous to those of quartermaster and commissary for all field parties, which will have many material wants in common.

While the methods of work and the selection of men should be left to the chiefs of the national scientific bureaus, viz., the members of the Board of Philippine Surveys, much latitude must be allowed the officers in charge of field work in so remote and exceptional a region as the Philippine Islands. On the other hand, if these officers are left entirely to their own judgment as to areas in which work is to be done in any given season, and as to the amount of detail requisite, there will be danger of lack of harmony in the results and delay in the progress of the work. To insure cooperation and to avoid duplication in the field work the following plan is suggested:

Let a scientific council be created in the Philippine Islands, presided over by a member of the Philippine Commission, to consist of the chief field officers of the several scientific bureaus present in the islands, as follows:

One geodesist, designated by the superintendent of the Coast Survey.

One hydrographer, designated by the superintendent of the Coast Survey.

One topographer, designated by the director of the Geological Survey.

One geologist, designated by the director of the Geological Survey.

One zoologist, designated by the chief of the Biological Survey.

One botanist, designated by the botanist of the Department of Agriculture.

One forester, designated by the chief of the Bureau of Forestry.

One anthropologist, designated by the chief of the Bureau of American Ethnology.

with whom should be associated one officer of Engineers, U. S. A., and one naval officer. Let this council meet once each year, for example, towards the close of the rainy season, and decide, in the interests of the Philippine surveys as a whole, what areas each bureau shall take up during the ensuing season, and with what degree of detail. It is believed that such a council would deal satisfactorily with all matters which might come before it, without lack of due regard to the expert opinions of the chief officers affected. In case of dissatisfaction, however, an appeal might be allowed to the governor-general. The findings of the council should be regularly reported to the Board of Philippine Surveys in Washington.

14. *Aid from Army and Navy.*—Except at the largest towns, it is seldom possible in the Philippines to obtain clothing or food such as Americans are accustomed to, and transportation facilities are very limited. For this reason it is recommended that the officers of the scientific surveys be granted permission to purchase supplies at military depots, such as army posts and naval vessels, and to avail themselves of opportunities of transportation on vessels attached to either service when such accommodation can be afforded without detriment to the military service.

15. *Cost and Time.*—This committee is not in a position to offer estimates of the cost of Philippine surveys. These could be easily furnished by the chief officers of the various scientific bureaus. It is believed, however, that with a moderate number of parties in each branch, under the system of cooperation recommended in this report, nearly all the work of exploration outlined above would be completed in a period of ten years, including charts, topographical maps and geological maps.

16. *Order of Importance.*—Should it be impracticable to organize the entire system of surveys simultaneously, it is recommended that they receive attention in the following order:

Coast and geodetic work and marine hydrography.

Land topography, including surveys and classification of the public lands.

Geology and mineral resources.

Botany.

Systematic forestry.

Zoology.

Anthropology.

This report was adopted by the committee on February 7, 1903.

William H. Brewer,
Chairman.
George F. Becker,
Secretary.
C. Hart Merriam.
F. W. Putnam.
R. S. Woodward.

ANTHROPOLOGY AND ITS LARGER PROBLEMS.

Youngest in the sisterhood of sciences, anthropology borrows principles and methods from all the older branches of knowledge; and her first problem—a problem renewed with each step of advance and hence endless as the problem of quarry to the huntsman or of crop to the planter—is that of determining her own relations in the realm of knowledge, her own place and powers in the intellectual world.

Viewed in the light of history, it is no accident that anthropology is the youngest of the sciences; for it is the way of knowledge to begin with the remote and come down to the near—to start with the stars, linger amid the mountains, rest awhile among rare gems, and only slowly approach such commonplace things as plants and animals and soils, to end at last with man. *How* growing knowledge has pursued paths leading from the remote to the near, from the rare to the common, from the abnormal to the normal, from the unreal to the real, from wonder to wisdom—indeed, from chaos to cosmos and from star to man—all this is history; *why* these paths have been pursued may well remain a problem until more is known of the constitution of the human brain and of the laws of mind.

Yet, viewed in the light of the relations among the sciences, it is no mere chance that the science of man rises from the hip and shoulder and head of the elder-sister sciences, as the family infant is borne by primitive folk; for the sciences have come up, just as the cosmos seems to have developed, in an order of increasing complexity. The stellar bodies are interrelated through gravity and various forms of molar force which may be combined under the term *molarity;* and astronomy in its earlier form was the science of these relations. As the planets took shape (whether through nebular integration or through planetisimal aggregation) chemical reactions became paramount over mechanical relations, and *affinity* was superadded to molarity; and in a parallel order chemistry was added to astronomy in the growth of knowledge. When our planet was encrusted and the great deeps were divided into sea and land, life appeared; and thereby *vitality* was superadded to affinity, and, concordantly, as knowledge grew, the biotic sciences followed the more exactly quantitative earlier branches. In cosmic time animal activity followed hard on more inert vegetal life, and *motility* was superadded to vitality; and in human time animals were domesticated soon after plants were cultivated, while zoology grew up nearly apace with phytology. As the earth aged into continental and seasonal steadiness and the struggle for organic existence grew strenuous, more and more of the battles were lost to the strong and the races to the swift, and were won by the intelligent, and thereby *mentality* was superadded to vitality as a factor in earth history and man came to his own as a mind-led monarch over lower life and a progressive conqueror of the natural forces; and in like manner, as human history matures, it records anthropology as the younger-kin of zoology. In a word, man, as the head and intellectual ruler over the realm of life, alone stands for all the fundamental forces of molarity *plus* affinity *plus* vitality *plus* motility *plus* mentality, and is interrelated alike with sun and planet, agent and reagent, plant and seed, egg and animal, and with groups of his own kind; and in a word, the science of man is, more than any other branch of knowledge, interdependent with all the sister sciences and more many-sided than any of the rest.

THE SETTING OF THE SCIENCE.

The scriptless nomads of the human prime (and of many lands) set their journeys by the stars and enshrined their beastly deities in the visible firmament, and thus astrology set out on a course still traceable through constellations and planet-myths; at the same time these mnemonic devices of the sky were mated with equally imaginative symbols of every-day things, and as these grew into geometric designs and arbitrary characters, a system of almacabala—the earth-placed twin of sky-set astrology—took a course still marked by the ancient hieroglyphs of many lands. In the fulness of time (and primitive progress was tedious beyond telling) astronomy grew out of astrology as the first of the sciences, leaving a large residuum of mythology behind. In like manner, and at about the same stage (*i. e.*, about the birth-time of writing), algorithm and algebra came out of almacabala, leaving a residuum of black art and white magic, jugglery and enchantment; and as the algorithm grew into arithmetic and wizardly geomancy gave way to scholarly geometry, mathematics took shape as the complement of astronomy—and these sisters twain were nurses and teachers of all the younger sciences. Still the caldron of inchoate knowledge boiled and bubbled with Macbethian pother, and the foul fumes of black magic long concealed the few germs of real knowledge shaped by the steady pressure of actual experience—for this was the time of alchemy, whose slimy spume at last slipped away from chemistry, the third of the sciences.

Astronomy led writing (as the constellations attest), while mathematics followed close on writing and records as its symbols show, and both belonged to what may be called the naissance of knowledge; chemistry appeared during the same period, bearing the prophecy of physics caught by Archimedes, yet remained a helpless weakling—the foil and puppet of medievalism—throughout the whole of the dark ages; but during the renaissance the trio of elder sciences gained strength together and assumed lasting dominion over the realm of knowledge. Because their birth dates back to or beyond the beginning of records, the early stages of these sciences are imperfectly written; but the youngest science, anthropology, buys methods and principles from the more exact elders and pays amply in coin of history—for by tracing the careers of later-born or slower-grown folk and cults, anthropologists learn to retrace the lost steps in the careers of ancestral peoples and early cultures. Here lie some of the relations between anthropology and the elder sciences; she receives exact methods tested by millenniums of experience, and gives interpretations of the ideas and motives, the arts and accomplishments, the modes of thought and the stages of progress of the earliest science-makers. Astronomy and mathematics and chemistry are systems of knowledge produced by men and minds, anthropology is systematic knowledge of these producers; and neither the old sciences nor the new can be rendered complete and stable without the support of the others.

The science of sentient man—of man as a thinking and collective organism—helps to illumine the dark ages no less than the naissance of knowledge; and at the same time it sheds new light on the origin of that group of modern sciences of which it is itself the youngest. The early period of intellectual activity in Babylon and Alexandria, Athens and Rome, may be likened to the blossoming of a plant in spring-time; it was the summing and outshowing of a mentality shaped during uncounted generations of experience along definite lines, in environments of distinctive sort—and the blossoming was fuller of promise than the ancients dreamed. Then came the ages that were dark because energy was diverted to new lines; for leaders of thought gave way to leaders of action, and these became pioneers in new environments where threads of new experience had to be spun from the lives of generations before they could be woven into the fabric of knowledge. The forefathers of the joint founders of scholasticism and science lived winterless lives in sunny lands, and the early science reveals an elysian tinge; while the ancestry of the makers of modern (or natural) science spent their force in conquering woodlands and wood-life in cloudy and wet and long-wintered Europe, and their efforts finally yielded a harder and more practical product than that of the earlier and easier time. During the nature-conquest of a millennium and more, the ideals of the elder masters seemed lost in a survival of astrology and alchemy, a survival so well recorded in growing literature as to simulate a revival; yet the sense of the reality of things gained strength by exercise in the ceaseless contact with nature, while the oft-told magic was relegated to beldams and crones rather than reserved for rulers and high-priests as of old. The Renaissance revealed the influence of these centuries of nature-conquest and nation-planting which made the Europe of history; and its dawn showed that the seat of highest intellectual activity had slipped in the darkness from the sensuous shores of the eastern Mediterranean to the remote and rugged lands in which the world's richest blood and ripest culture were blent and pent against northern seas. The closest concentration of human strength was in Britain, the uttermost goal of conquest, the last resting-place of the conquerors of conquerors, where Cæsar might have wept for worlds like Alexander long before; and here modern science began with Francis Bacon (1561–1626) as expounder. The Britainian Renaissance coming so long after the Mediterranean Naissance may be likened to the ripe-fruiting of a plant in autumn; for it followed the vernal blossoming after a tedious interval of scarce-seen growth.

With the 'Novum Organum' of Bacon, the last vestige of magic and mysticism fell away from the body of real knowledge; for not only was the practicality of centuries summed in the new system, but its author saw more clearly than any predecessor the relation between the thinker and his thought, between the human mind and the rest of nature—he perceived that 'Man * * * does and understands as much as his observations on the order of nature * * * permit him, and neither knows nor is capable of more.' On this and kindred verities he built a foundation for all the sciences, for the unwittingly-wandering elders as well as for those yet unborn, even down to anthropology—though this part of the foundation lay unused for three centuries. Bacon's influence on contemporary and later thought was steady, albeit slow-felt; for his school was a normal by-product of the making of Europe, and he was the exponent of principles themselves the product of the world's most significant chapter in human development. True, the next epoch was opened by a son of southern shores and a devotee of the oldest science when Galileo (1564–1602) saw the sun-centered order of the solar system; yet it was left to English Newton (1642–1727) to shape the epoch and systemize all astronomy by a law of gravitation based on commonplace observation, while the third epoch of modern science came with Linné (1707–1778), like Bacon and Newton a product of the harsh northland and an exponent of practical experience, who led conscious seeing down from the stars to the plants and animals of daily knowledge. Of all the world's thinkers Linné would seem second only to Bacon in originality, if that quality be measured by grasp of realities; and while his system was crude, especially in relation to animals, his gift of phytology (or botany) enriched knowledge and opened the way for the rest of the natural sciences. Linné, the Swede, was soon followed by Hutton, the Scot (1726–1797), with a practical science of the rocks long contested by Werner, the German (1750–1817), under a theory smacking of Alexandria and Athens; but the sturdy English quarryman, William Smith (1769–1839), successfully supported his northern neighbor until his countryman, Lyell (1797–1875), came up to make geology a science. The influence of these sons of woodland and wold extended rapidly and widely, rooting readily in the fertile minds of their kinsmen, while the printing-press spread the stimulus of their work over all Europe and unified the knowledge of the nations.

The next act attested the blending of the ancient and the modern, of Athenian and Anglican, of Aristotelian and Baconian, of the southern and the northern, and the scene was the middle ground of France. There Lavoisier (1743–1794) applied modern practicalness to chemistry, and discovered the indestructibility of matter; Lamarck (1744–1829) sought to amend the Linnean system, yet pushed too far in advance of observation (and his times) for full following; and the brothers Cuvier (1769–1838) so improved on Linné as to give form and substance to zoology, and incidentally to presage anthropology. These movements led up to the distinctively nineteenth-century stage, and a renewed pulse of British activity; Joule and others measured the mechanical equivalent of heat and experimentally demonstrated the persistence of motion, and so founded physics; by masterly observation and comparison, Darwin defined the development of species (including man), thus infusing the blood of life into the Linnean system; Huxley and Tyndall simplified all science by establishing the uniformity of nature; and at last American scions of Anglican sires independently discovered through anthropologic observation that the minds of all men of corresponding culture-grade respond similarly to similar stimuli, thereby proving the soundness and completeness of the Baconian foundation of knowledge. The four laws of nature established in western Europe—the indestructibility of matter, the persistence of motion, the development of species and the uniformity of nature—are, in fact, complementary to the law forecast by Bacon and applied in America three centuries later as the responsivity of mind; and the five laws are the cardinal principles of science. It is curious that while Bacon's view of the mind as a faithful reflex of other nature colored and shaped the progress of science through the centuries (for how could Lavosier, or Joule, or Darwin, or Huxley repose confidence in their observations without resting even greater confidence on the accuracy of the observing mechanism?), the Baconian law lay in the background of thought without conscious expression (despite daily subconscious use) from the dawn of the seventeenth century down to the last quarter of the nineteenth. *How* the law was neglected is the history of modern science read between-lines; *why* it was neglected until the science of sentient man arose to rediscover it is a present problem for those anthropologists whose sympathies and interests cover the full field of human knowledge.

Howsoever the three-century eclipse of Bacon's fundamental law be interpreted, the history of science stands out sharp and clear when viewed in the light of anthropology: There were two great movements, the naissance in the east Mediterranean region, and the renaissance commonly credited to the Mediterranean countries but really made in the North Sea region; each comprised a long interval of accumulation of experience and a briefer time of formulation of knowledge; in each the formulated knowledge faithfully expressed the habits and characters of leading thinkers of the times; and the modern movement reached the commonplace thing of every-day life in such wise as to render science a devoted handmaid rather than a remoter deess, a means of welfare rather than an end of aspiration. The anthropologist feels that the comprehensiveness of the ancient and the practicalness of the modern unite in his science, which (despite the narrow definitions of earlier decades) is that of mind-controlled man, the dominant power of the visible world, the science-maker as well as the subject of science.

Such are a few of the relations of anthropology to the sister sciences, a few of the ways in which the science of sentient man touches the sum of human knowledge; to catalogue all would be an interminable task.

THE RISE OF ANTHROPOLOGY.

When the science of man grew up in the North Sea region, it was at first little more than a branch of zoology, and its makers busied themselves with features of the human frame corresponding to those of lower animals; comparative anatomy was cultivated with assiduity and profit, anthropometry flourished, and mankind were apportioned into races defined by color of skin, curl of hair, slant of eyes, shape of head, length of limb, and other structural characters—*i. e.*, the methods and principles of zoology were projected into the realm of humanity. It was during this stage that homologies between human structures and those of lower animals were established in such wise as to convince attentive students that mankind must be reckoned as the ennobled progeny of lower ancestry; true, the conviction grew slowly against the instinctive antagonism of the investigators themselves and the less effective (though louder) protests of contemporaries, yet the growth was so sure that the question of the ascent of man is no longer a problem in anthropology. Meantime the masters—and here Huxley and Darwin must always rank—gave first thought to normal and typical organisms; their disciples followed the same commendable course, and as other lines of man-study opened they called their work physical anthropology. One of the collateral lines reverted to the abnormal (in which knowledge commonly begins) and recurved toward the Mediterranean (where the influence of Alexandria and Athens lingers still) to mature in criminal anthropology—the science of abnormal man; another line led through prehistoric relics to archeology, and still another stretched out to the habits and customs of primitive peoples, and eventually to comparison of these with the usages and institutions of civilized life. The last of these lines was laid out in Britain largely by Tylor, and was pursued in Germany and other European countries as general anthropology, ethnography, anthropogeography, etc.

Even before this growth began, a development not unlike that accompanying the making of Europe (save that the progress was more rapid) was under way in America; for the pioneers not only pushed out into their wilderness like their forebears of generations gone, but faced the novel experiment of life in contact with savage or barbaric tribes. To this new stimulus their vigorous minds responded promptly; the daily experiences were quickly flocked on distaffs of thought, spun into threads of knowledge, and duly woven into a web of practical science—a fabric no less independent in the making than that of Bacon in his day. Notable among the American pioneers was Albert Gallatin (1761–1849), statesman and scientist; he not only perceived, like his fellows, that the color and stature and head-shape of tribesmen were of trifling consequence in contrast with their actions and motives, but that the index to their real nature was to be found in what they habitually did; and he summed American experience up to his time in a preliminary classification of the native tribes on the basis of language. This advance marked an epoch in science no less important than that of Linné; true, it was not minted at a stroke nor finished without aid from others; yet Gallatin was the coiner, and the rough-stamped system was history's most memorable essay toward the scientific arrangement of mankind by what they *do* rather than what they merely *are*. Later Morgan (1818–1881) extended practical observation to the institutions of the aborigines in such wise as to found inductive sociology;* and still later Brinton (1837–1899) made noteworthy advances toward classifying the Amerinds (*i. e.,* the native tribes) by their own crude philosophies, thus forecasting an inductive science now called sophiology. These advances seem simple and easy in the light of present knowledge, and may look small to present backsight; yet in originality of work and boldness of conception they rank with the advances of Linné and Lavoisier—and be it remembered that they were not borrowed in any part, but bought at cost of the sweat and blood of often tragic experience. The unprecedented practicalness of American anthropology is attested by the fact that while Morgan and Brinton still wrought (in 1879) a governmental bureau was created to continue the classification of the native tribes; and its direction was entrusted to Powell, a master able not merely to occupy, but greatly to extend, the foundation laid by Gallatin. Under this impetus the new science progressed apace; American students multiplied; observations spread afar; each discovery prepared the way for others, and the new principles opened to scientific view the entire field of the humanities—that field aforetime claimed on one side by scholastic and statist, and held on the other by devotees of poesy and romance. The growing knowledge bridged the seas and the Powellian product blent with that of Tylor (both profiting by the experience of British India), and pushed on to several continental centers during the last two decades of the nineteenth century.

Toward the close of the old century, what may be called the kinetic and collective characters of humanity were brought out clearly and the American aborigines (with other peoples as well) were defined by the *activities, i. e.,* by what they *do,* and this collectively—for in the realm of humanity no one lives to himself alone, but all are joined in twos and larger groups. Now it can not be too strongly emphasized that the basis of this definition differs fundamentally and absolutely from that of any other science; for all other entities—stars and planets, molecules and ions, minerals and rocks, plants and animals—are defined by what they *are* (perhaps measurably by the way in which they respond to external forces), while the humans are defined and classed by what they *do* spontaneously and voluntarily as self-moving and self-moved units or groups. Necessarily this view of humanity awakens inquiry as to why the human entity stands in a distinct class among the objects of nature; yet this is hardly a present problem, since the makers of modern anthropology find full answer in that unique nature-power lying behind the kinetic character of unit or group, viz., *mentality.* So in the last analysis the modern definitions of mankind are primarily psychic; and it matters little whether men are classed by what they *do* or by what they *think,* save that doing is humanity's largest heritage from lower ancestry and hence precedes thinking—the essential point is that the practically scientific classification of mankind must rest on a kinetic basis, *i. e.,* on self-developed and self-regulated conduct.

Of late the activities themselves are grouped as arts, industries, laws, languages and philosophies, and each group constitutes the object-matter of a sub-science, thus giving form to esthetology, technology, sociology, philology and sophiology; and these (together called demonomy, or principles of peoples), with somatology and psychology, make up the field of fin-de-siècle anthropology—the last two corresponding, respectively, with the physical

* The speculative sociology of Auguste Comte (1793–1857) and the semi-speculative system of Herbert Spencer are to be noted merely as standing on somewhat distinct bases.

anthropology of most European schools and the strictly inductive mind-science of current American schools, while the first two include archeology as their prehistoric aspects. These outlines and partitions of the groups are essential, although in actual interest they lie beneath the full fruitage of the field as a wire-hung skeleton lies below the sentient body athrob with vitality and athrill with consciousness of power over lower nature. This fruitage is too large and luxuriant for ready listing; it need now be noted only that, in the modern anthropology sometimes styled the new ethnology, the peoples of the world are not divided into races (save, perhaps, in secondary and doubtful fashion), but grouped in culture-grades, and that these culture-grades are of special use and meaning in that they correspond with the great stages of human progress from the lowly and unwritten prime to the brightness of humanity's present.

The culture-grades (and progress-stages) may be defined in terms of arts or of industries, of law, of languages or of philosophies, and the definitions will coincide so closely as to establish the soundness of the system, though it is customary to define them in terms primarily of law (or social organization) and secondarily of faith or philosophy. So defined the grades (and stages) are: (1) savagery, in which the social organization is based on kinship traced in the maternal line, while the beliefs are zootheistic; (2) patriarchy or barbarism, in which the law is based on real or assumed kinship traced in the paternal line, and in which belief spreads into pantheons including impressive nature-objects as well as beasts; (3) civilization, in which the laws relate mainly to tenure of territorial and other proprietary rights, while the philosophies grow metaphysical and the beliefs spiritual; and (4) enlightenment, in which the law rests on the right of the individual to life, liberty and the pursuit of happiness, and in which the philosophy is scientific or rational, while the faiths grow personal and operate as moral forces. The peculiar excellencies of this classification lie in its simplicity, and in the fidelity with which it reflects the unique nature-power lying behind the kinetic character of the human entity, *i. e.*, mentality; for, in the last analysis, the stages but portray and measure the normal growth of knowledge. Thereby the system sets milestones in the path of human progress, in numbers sufficient to outline its trend with satisfactory certainty; and it is especially notable that this trend is from the lower toward the higher with respect to every distinctively human attribute.

So anthropology came up, chiefly on the western hemisphere and under the stimulus of unique and strenuous experiences; and so it has assumed form and substance and spread widely over the world during two decades past. Viewed from its own high plane, the growth of the science presents no puzzling problem; yet, since no mind leaps lightly from classification on a static basis (as in somatology and its parent zoology) to classification on a kinetic basis (as in demonomy), the modern aspects of the science are full of problems to some students.

PROBLEMS OF CLASSIFICATION.

While the essential characters of mankind reside in mind-shaped activities, it remains true that the mental mechanism is planted in a physical structure derived from lower ancestry by uncounted generations of development; and the problem as to the weight properly assignable to hereditary structural characters in classifying men and peoples remains, in many minds, a burning one. As an academic problem, this may be said to distinguish the new anthropology from the old, and to divide the anthropologists of the day into opposing schools, one chiefly American, the other chiefly European; as a practical problem of applied science, it has already engaged the attention of the world's leading statesmen (most of them approaching it empirically under the law that doing precedes thinking) and, with such help as they have been able to secure from science, they have solved it to their satisfaction, and have declared in numberless constitutional and statutory provisions that red and black, if not yellow, men share with whites the potency (at least) of enlightened citizenship, and should be led and aided and educated toward that goal despite the handicap of heredity. Here the highest statecraft and the most advanced anthropology strike hands; the statesman argues from his own experience that lowly men may be raised up, and hence that it were heartless to strike them down; the scientist but sums more numerous observations when he traces the upward trend of humanity; and both stand firmly on the rock of experiential knowledge. True, practical questions involved in the general problem are constantly arising: Can the Apache at San Carlos best be led toward citizenship by penalties for misdeeds, by rewards for righteousness, or by a combination of the two? Does the hereditary structure of the Negrito of interior Luzon debar him from hope of free citizenship, including that rectitude of conduct and nobility of impulse which free citizenship requires? Can the fellahin of Egypt be lifted from the plane of subjection to despotism to that of intelligent loyalty as royal subjects? Will the educational qualification in Maryland elevate the franchise? These are among the multifarious and ever-rising questions involved in the problem; and while the old anthropology stands aloof, they are receiving yearly solution at the hands of modern science and modern statecraft. Fortunately, this present problem of anthropology is no less practical than were those confronting pioneer Puritans and Cavaliers in an earlier century, and like those it must be wrought out through living experience; still more fortunately, the chief factors in the problem are now grasped by students taught in the severe school of the settlers—grasped so firmly that little remains undone save the bringing up of loiterers who linger in the haze of half-knowledge and harken idly to bookish echoes of simpler science.

Connected with this problem is another no less burning: Does the mental mechanism of mankind react on physical structure in such wise as to control the development of individuals and types? As an academic problem this is well-nigh lost in the dust of ill-aimed discussion (relating to the hereditability of acquired characters and a dozen other points) which it were indiscreet to stir; yet half an eye can see that, whatsoever pedagogues proclaim, the pupils are building bone and muscle, increasing strength and stature, and manifestly promoting brain-power and prolonging life by judicious regimen. As a practical problem this might be passed over, since the world's leading millions are so well advanced in doing that thinking may be trusted to follow duly (perchance soon enough to let the masters learn the lessons their pupils live), were it not for the ever-rising ancillary questions as to rate and trend of the progress. Thus, mean length of life, or viability, is increasing, especially among more advanced peoples, who live longer in proportion to their advancement; yet, although Mansfield Merriman computed a few years ago that the median age of Americans has gone up five years since 1850, while the twelfth census reported that our mean age of death had advanced from 31.1 years to 35.2 years in a decade, it can not be said that the rate of increase is known—and still less are the factors of increase (saving of infants, improved sanitation, bettered hygiene, shortened hours and intensified stress of labor, enhanced enjoyment of life, and all the rest) susceptible of statement in terms of definite quantity. The various questions of viability (than which no inquiries mean more to living men) are not to be answered through actuaries' tables based on selected classes, valuable and suggestive as these tables are; they must be answered through health offices and census bureaus—and their pressing importance forms one of the strongest arguments in support of permanent census bureaus in this and other countries. Thus, again, human strength is increasing, as suggested by the superior vigor and endurance found among advanced peoples and rising generations, and shown definitely by the constant breaking of athletic records; yet, while it is most significant that record-breaking progresses at an increasingly rapid rate (*i. e.*, more records are broken during each decade than during the last), the rate of increase remains problematic. Similarly, that measure of faculty expressed in coordination of mind and body is increasing, as shown by the ever-growing and never-failing ability of engineers, mechanicians, builders, electricians and other specialists to master and command the strength-trying devices of modern times—locomotive and marine engine, dynamo and steam hammer, range-finder and machine-gun, and all the rest; yet both the rate and the factors of increase in human faculty remain in the realm of the unmeasured. These are but sample questions ancillary to the practical problem as to the reaction of function on structure; they merely suggest ways in which mind born of body in humanity's prime is rising into dominion over fleshly organ and constitution, as well as over subhuman nature—and these ways remain for the future to trace.

A related problem, although minor in itself, has recently risen into prominence through the impetus of importation oversea; it is that of 'degeneracy.' The observational data for the idea of human retrogression are apparently voluminous (though seen to be mainly of opposite meaning in the light of modern human knowledge) and the notion is by no means new; but the ratiocinative basis of the recent fad is obviously chaotic, *e. g.*, in that an individual is classed as 'degenerate' by reason of the inheritance of ancestral characters, or in other words, because he is no better than his sire or grandsire. True, if normal man is rising to successively higher planes of physical and mental perfection through constructive exercise, as modern anthropology so clearly indicates, the unfortunate who is no better than his ancestry is indeed below his proper place in the scheme of humanity—though not degenerate, but merely unregenerate (in non-ecclesiastical sense). It is also true that maleficent exercise may produce cumulative and apparently aberrant effects, just as does the beneficent exercise normal to mankind, the one yielding Nero and Billy the Kid as the other Shakespeare and Bacon, twin luminaries in intellectual history; but its end is destruction, with the consequent elimination of the criminal, while its middle merely marks lower layers in the constantly ascending stream of humanity. Naturally a theme filling tomes and flooding lighter literature for years is too large for full analysis in a paragraph; it must suffice to note that the 'degeneracy' of the day was not unfitly characterized even so early as when aphorism foreran writing, and the proverb beginning 'Put a beggar on horseback' gained currency. The great facts are (1) that less vigorous individuals fall short of the mean progress of their fellows in such wise as to get out of harmony with the institutions framed by their leaders, and (2) that less vigorous peoples fall behind contemporary law-makers in such wise that their institutions are inferior to those of progressive nations; while under the conditions of modern life laggards and leaders commingle so freely that the differences are emphasized and kept in mind. Nor are these differences slight or meaningless; they touch the very fiber of living and being so deeply that primal savages can not share the thought of those in any higher culture-stage, that barbaric serf and despot are wholly alien to subjects and citizens, and that subjects are out of place among citizens. So every advanced nation has its quota of aliens through foreign or ill-starred birth and defective culture, who can be lifted to the level of its institutions only through a regeneration extending to both body and mind, both work and thought—they are the mental and moral beggars of the community who may not be trusted on horseback, but only on the rear seat of the wagon. In truth, standards are rising so rapidly that the lower half find it hard to keep up.

In one aspect the problem of the unregenerate is ever pressing, since knowledge is not yet a birthright (save in the promising germ of instinct) among human scions of lower ancestry; but even in this aspect a progressive solution is wrought with ever-increasing success through public education. The most serious side of the problem arises in the immigration or upgrowth of the unfit, who sometimes ferment in the unwholesome leaven of anarchy before education has time for perfect work; and this danger cries out for public action through the blood of both presidential and monarchical martyrs to public duty. The morbid view imported by Nordau and his ilk demands little American notice, however large the problem in Europe; for under the stimulus of that personal freedom which is the essence of enlightenment, normal exercise of mind and body springs spontaneously, while hereditary disease, constitutional taint, idiocy, unhealthy diathesis, and all manner of transmissible abnormalities tend to wear themselves out, as our vital statistics sufficiently show.

These are a few of the present problems of anthropology involved in classifications growing out of the dual nature of mankind—the physical nature inherited from lowly ancestry and the mental nature (in all its protean aspects) built up through exercise during uncounted generations of functional development. They may seem irrelevant to that archaic anthropology which is content to define mankind by skulls of the dead; but they illustrate the living importance of that modern science which defines mankind by actions and thoughts, movements and motives.

MEANING OF ACTIVITAL COINCIDENCES.

About 1875 archeologists, and after them students of primitive folk still living, became impressed with certain similarities among industrial and symbolic devices of remote regions. One of the widespread devices is the arrow; used commonly with the bow, sometimes with the atlatl or throwing-stick, and again as a dart projected by the hand alone, it has been found on every continent and in nearly every primitive tribe. Another is a quadrate or cruciform symbol; either in the form of a simple cross or in that of the cross with supplementary arms known as the swastika or fylfot, these symbols are common to Europe, Asia, Africa, both Americas, and numerous islands, though they have not been found in Australasia. At the outset such devices were accepted as links in a chain of suppositious relationships, and as suggestions of common origin of both devices and devisers; but as observations multiplied, the hypothetic chain broke beneath its own weight, for the few similarities were gainsaid and far outweighed by numberless dissimilarities of a sort manifestly attesting independent development. About 1880 Powell summarized the observed resemblances and differences among devices, and showed that the former are to be regarded as coincidences due to the tendency of the human mind to respond to contact with external nature in a uniform way. A dozen years later Brinton resumed the growing data and corroborated the Powellian conclusion; and on extending the inquiry to institutions, forms of expression and types of opinion and belief (in which the coincidences are even more striking than in the material devices), he formulated a theory of 'the unity of the human mind,' in which he saw a suggestion that the mind was extraneous in origin, *i. e.,* impressed on mankind from without—a view not unlike that long maintained by Alfred Russel Wallace. With the setting of the old century and the dawn of the new, the ever-multiplying facts were again reviewed, and the earlier generalizations were again sustained, but found to tell less than the whole story; for it was discovered that while minds of corresponding culture-grade commonly respond similarly to like stimuli, minds of other grades frequently respond differently—as when the savage eviscerates an enemy and devours his heart as food for courage, or the barbarian immolates a widow on the bier of her spouse, or the budding christian lends himself to the tortures of the inquisition, each reveling in his own righteousness and reprobating all the rest, though all are alike ghastly and obnoxious to enlightened thought. The new generalization rendered it easy to define the limits within which the responses of different minds to similar impressions may be expected to coincide; thereby it cleared away many of the anomalies and apparent incongruities among the observed facts, thus strengthening the law of activital coincidences as first propounded. The introduction of a limiting term also rendered the law more specific; so that the sum of knowledge concerning the relations between mind and external nature may now be expressed in the proposition: *Minds of corresponding culture-grades commonly respond similarly to like stimuli.* By far the most important effect of the new generalization was the inevitable recognition of a cumulative mind-growth in passing from savagery to barbarism, thence to civilization, and on to enlightenment; for, in the first place, this recognition afforded a key to—indeed a full explanation of—the sequence of the culture-grades, while, in the second place, it showed forth the course of the world's mental development as a growth no less natural than that of tree or shrub, originating within, conditioned by external environment, and not derived from any extraneous source. Thus the generalization in 1900 of a quarter-century's observations on mankind brought empirical knowledge to the theoretical plane so masterfully projected by Bacon three centuries before—for it was he who first grasped the great concept that mind is at once product and mirror of other nature.

Is the Baconian foundation for all science sound; is the most sweeping generalization of anthropology safe? This problem—for the two questions are but one—is the most important presented by the science of man, indeed by all science; for it threads the whole web of human knowledge, touches every human thought, tinctures every human hope, tinges every human motive. True, it is too large for easy apprehension, too round for ready grasp, but it spans the world's intellectual structure from corner-stone to dome, and must sooner or later be wrought out personally (as are all problems in the end) by each rational being.

PROBLEMS OF DISTRIBUTION.

Anthropology arose in Britain as a branch of biology fertilized by the doctrine of organic evolution; it grew up in a field of thought dominated by a tradition of human descent from a single pair and shaped by the habit of tracing nearer ancestry to the worthier sires in otherwise neglected lineage—and the coincidence of the doctrine of differentiation with revered tradition and honorable regard for honored sires led naturally to an assumption of monogenesis. The assumption spread and pervaded the writings and teachings of anthropologists trained in the biological school; it still prevails, and is still supported by the argument from biology, though Keane and others have balked at the corollary that wavy-haired white, kinky-haired black, straight-haired red, and variable-haired brown nestled in the same womb and suckled at the same breast. It is needful to note that the assumption, albeit perfectly 'natural,' is purely gratuitous, and that it is not sustained by a single fact in anthropology as a science of observed and observable actualities: the blacks are not growing blacker, the reds are not blushing redder, no new races are arising, no old types are increasing in diversity; Graham Bell's note of warning against the danger of a deaf race advertised a solitary definite suggestion of the formation of a new human type, though even this seems to weaken with the lapse of time; indeed, it can not be too strongly emphasized that, howsoever besetting and enticing the hypothesis of differentiation or diversification of *Homo sapiens* may be, it is absolutely without direct observational basis.

When practical anthropology arose in America, it was seen by Gallatin and Morgan and other pioneers that languages and social usages tend to spread among contiguous tribes; and as Indian students advanced it was perceived that the tendency toward activital interchange extended also to arts and industries and myths, and had, indeed, resulted in the development of powerful federations (somewhat miscalled 'nations'), such as the Iroquois League and the Dakota Confederacy. Meantime it was observed that the spontaneous interchange of words and weapons, usages and utensils, with contiguous tribes was sooner or later accompanied by intermarriage, so that blood and culture blent together. Of course this observation merely reflected the unwitting experience of every generation among every people in every land; but, made as it was under the stress of practical problems of polity and peace, it awakened consciousness—and the *law of convergent development* among mankind was grasped. Once realized, the law was found of wide application; it was perceived that black folk are not growing blacker, nor brown men browner, nor red tribesmen redder, but that (among other relations) some interchange of culture and blood begins with first contact and increases with time, until at least some of the leaven of the highest humanity pervades the lump, while the ideals and standards of all progress toward unity; it was perceived that the types of *Homo sapiens* (*i. e.*, the 'races' of mankind) are not differentiating, but bent by that irresistible mimetic impulse which is the mainspring of elevation especially among the lower and measurably among the higher; it was perceived that culture is fertilized by contact with other culture more effectively than in any other fashion; and it was perceived that when the initial differences are not too great, blood fertilizes blood in such wise that the vigor of a people may be measured by the complexity of their interwoven strains—that European yesterday and American to-day led and still lead the world because the blood of each streamed up from a more varied group of vigorous sires than that of any earlier scion. The themes of culture-union and blood-blending are too broad and deep for treatment in a paragraph; yet it must be affirmed, with an emphasis which can hardly be made too strong, that these are the dominant factors of human development, and that this development, so far as actually observed, is always convergent, never divergent.

Now it is a logical corollary of the law of convergent development that mankind were originally more diverse than now, and hence that there must have been several *loci* or centers of human origin; and this corollary leads to a theory of polygenesis, which has been much discussed during a decade or two. Some of the polygenesists, like Keane, are content with four original stocks, corresponding, respectively, to the white, black, brown and yellow 'races' of mankind (leaving the red man, or Amerind, to be interpreted perhaps as a migrated branch of the brown stock); others, like Powell, find it easier to think of an indefinitely large number of initial stocks and centers of development from a hypothetic prototype to the 'human form divine'—a prototype represented, perhaps, in a particular place by the famous fossil from Java, the *Pithecanthropos erectus* of Dubois. The alternative hypothesis is that of the monogenesis assumed in the early days of man-science; and the choice—or adjustment—between these opposing views is one of the most prominent among the present problems of anthropology. The great facts are (1) that all known lines of human development are convergent forward and hence divergent backward, and (2) that all well-known lines of biotic (*i. e.*, sub-human) development are divergent forward; how these incongruous lines are to be united across the dark chasm of that unknown time when man became man remains a question, only made larger thus far by each advance of knowledge.

THE PROBLEM OF HUMANITIZATION.

To the comparative anatomist the gap between simian structure and human structure was of little note even before it was divided by the Dubois discovery in Java; for the differences between higher apes and lower men are less than those between either (1) lower and higher apes, or (2) lower and higher men. Yet to the sympathetic student of mankind these dead homologies are but unsatisfying husks—the great fact remains that even the lowest savage known to experience is human—man—in attitude, mien, habits and intelligence, while even the highest apes are but bristly beasts. It were bootless to deny or decry the chasm separating the always human biped from the always beastly quadrumane, since it is the broadest in the entire realm of nature as seen by those who appreciate humanity in its fulness. How the chasm was crossed, either in the one place and time required by monogenesis or in the many places and times demanded by polygenesis, is a question of such moment as to rank among the great problems of anthropology until (if ever) the solution is wrought. A tentative solution has, indeed, been suggested in the modified form of mating which must have attended the assumption of the erect attitude; yet final solution awaits the future.*

THE PROBLEM OF HUMAN ANTIQUITY.

So long as the assumption of monogenesis prevailed, the question of the antiquity of man loomed large in the minds of students, while even under the hypothesis of polygenesis the date (geological or historical) of advent of the earliest man is of no small interest. So the discussion of human an-

* 'The Trend of Human Progress,' *American Anthropologist*, Vol. 1., 1899, p. 418.

tiquity has grown into dozens of full volumes, hundreds of chapters and thousands of special papers, not to include the tens of thousands of ill-recorded scientific utterances and literal millions of press items. This vast literature is not easily summed; it must suffice to say that the evidence seems to establish the existence of man in Asia and Europe and northern Africa during later Tertiary times, and thus before the glacial periods of the Pleistocene; but that the earliest Americans lagged behind, coming in probably before all the ice-periods closed, possibly nearer the earlier than the latest. Despite the wealth of literature, there is a woeful dearth of definite knowledge concerning the date or dates of man's appearance in different lands—and herein lies another of the present problems of anthropology.

Such are some of the larger problems of anthropology, that youngest science whose field touches those of all the rest. The special problems are legion: those of general sort are at once problems of science and of statecraft, of the daily life and welfare of millions, of greatest good to the greatest number. Fortunately all are such as to be solved by the slow but sure processes of observation and generalization; and it is especially pleasing to see—and to say—that these scientific processes are more steadily and successfully under way now than ever before. W J McGee.

SCIENTIFIC BOOKS.

Post-mortem Pathology: A Manual of Post-mortem Examinations and the Interpretations to be drawn therefrom. A Practical Treatise for Students and Practitioners. By Henry W. Cattell, A.M., M.D. Second revised and enlarged edition. Philadelphia and London, J. B. Lippincott Co. 1905. Pp. xii + 551. Copiously illustrated.

Pathological anatomy as a control of clinical observation has formed, and to a large extent still forms, the main basis of our more exact knowledge of disease. After the study of human anatomy had revealed to them the parts into which the body is divided, it was a very natural curiosity which prompted medical men to examine after death the bodies of human beings who during life had manifested phenomena which deviated from the normal. Indeed, before the era of modern experimental inquiry developed in medicine, facts of normal and pathological physiology had for the most part to be reached through the combined results of clinical and post-mortem observation. The discovery of the seat of disease, it was believed, would be most helpful in leading to a knowledge of its cause; this idea was shared by Morgagni, the distinguished founder of the science of pathological anatomy, as is evidenced by the title of his chief treatise: *De sedibus et causis morborum per anatomen indagatis,* and it was believed in by the great pathological anatomists, like John Hunter, who followed him.

At first, post-mortem pathology confined itself largely to the determination of variations in the gross form, consistence, appearance and weight of the more conspicuous organs, but gradually this naked-eye study became extended in a methodical way to all parts of the cadaver until to-day the macroscopic side alone of a completely performed autopsy has assumed formidable proportions. The microscopic study of pathological anatomy received a great impetus in the first half of the last century through the activities of the so-called pathological-anatomical school in France, the representatives of which, including Cruveilhier, Chomel, Andral and Louis, maintained that one of the chief functions of the physician consists of a search for pathological-anatomical alterations and of the investigation of the local products of disease; this view exerted an extraordinary influence in transforming the methods and theories of medical men. The tendency was transplanted by the celebrated Rokitansky to Vienna, where it was further developed. It reached its acme, however, in the work of Virchow, who, passing from macroscopic studies to microscopic examinations and taking advantage of the histological discoveries which were being made, founded the so-called 'cellular pathology,' which refers all vital process, including the phenomena of disease, and all alterations of the organs and tissues, to the activity of the cells of which the body is composed. Microscopic pathological anatomy has been enormously in vogue since the middle of the last century, and histological technique has gradually attained to a manifoldness and complexity which is nothing less than appalling.

Still another phase of post-mortem pathology appeared when the relation of certain micro-organisms to the infectious diseases began to be established. Following upon the discoveries of Pasteur and Koch, the methods of bacteriology were applied at autopsies and our knowledge of disease has, as every one knows, been notably forwarded through such application. American pathologists especially have insisted upon systematic routine bacteriological examinations at autopsies.

Finally, the chemical study of the organs and tissues at post-mortem examinations remains to be developed. Only the crudest of beginnings has been made thus far in this direction; the whole field is as yet practically unexploited. That the time is about ripe for its cultivation seems obvious to many; a German scientist, writing to a friend in this country the other day, made the prophecy: 'Der zweite Virchow wird ein pathologische Chemiker sein.'

Coincident with the expansion of the subject, the technique of post-mortem pathology grew in extent and complexity. Two or three main types of books have been published as guides thereto—small works like those of Virchow, Chiari and Nauwerck, large books like Orth's 'Pathologisch-anatomische Diagnostik,' and others of intermediate size such as Mallory and Wright's 'Pathological Technique.' The volume before us, by Dr. Cattell, is of about the same size as Orth's book, but the plan followed is somewhat different and the subjects dealt with are more numerous.

After certain introductory chapters on the general features of post-mortems, the order of examination, the keeping of records, the use of instruments, and the care of the hands, the author takes up the examination of the external surface of the body. Then follows the opening of the great cavities and the study of their contained organs, the examination of the nervous system, of the sense organs, and of the bones and joints. Intercalated between the description of methods of examination, the diseases which may be met with in the individual organs are described and the corresponding pathological changes referred to. The first seventeen chapters of the book are devoted to the above-mentioned portions of the subject. The accounts given, though brief, are clear, and on the whole commendable. Occasional slips are made, some of them, perhaps, due to compression, as, for example, the classification of osteitis deformans under acromegaly.

The post-mortem examination of the new-born is dealt with in chapter XVIII.; in chapter XIX. the making of restricted post-mortem examinations is discussed, and in chapter XX. the student is told how to restore and preserve the body. The mode of preparation of the tissues for macroscopic and microscopic purposes occupies a special chapter, as does the topic of bacteriological investigation. Comparative post-mortems receive especial attention; one whole chapter is devoted to medico-legal suggestions, and another to an account of the Prussian regulations for the performance of autopsies in medico-legal cases. Toward the end of the book the usual causes of death are classified, and their nomenclature, complications and synonyms successively taken up. The volume closes with twenty-four pages in italics of references to the literature of the subject.

It will be seen from the above statement that many phases of post-mortem pathology rarely dealt with extensively in text-books have been carefully considered by Dr. Cattell. The number of methods given for any particular procedure varies; in some instances only the method of examining an organ preferred by the author is described; in other cases, a whole series of different methods is outlined, *e. g.*, for the examination of the brain, where Virchow's, Meynert's (modified), Pitres', Dejerine's, Hamilton's and Giacomini's methods, are all separately described. The different chapters are copiously illustrated, largely by means of half-tone reproductions or photographs of stages of actual autopsies. Indeed, the book is much more fully illustrated on the side of macroscopic technique than are most manuals; there are only a few pictures, however, representing anatomical lesions. The index is full and well-arranged.

The fact that a second edition has been called for within two years of initial publication indicates that the book has met a distinct need in the country. Several improvements over the first edition have been introduced, including the chapter on the bones and joints, and nearly thirty new illustrations. Important changes have also been made in various chapters during the revision. The parts of the book dealing with the more modern and refined methods for microscopic examination of the tissues might with advantage be expanded in another edition; room for this could be obtained, perhaps, by omission of some of the chapters on pathology proper, as the latter will be thought by some to be too long for a book on autopsy-making and yet they are not full enough to serve as a textbook of pathology. There are but few things connected with autopsies that will not be found mentioned in the volume. Some professors of pathology may be inclined to use smaller manuals in connection with their practical teaching, urging that more than Dr. Cattell thinks desirable should be left to the intelligence of the student; instructors who desire a full account of all the technical processes, helped out by a large number of good illustrations, will find what they want in this book.

The publishers, too, have done their work well. The volume is satisfactorily made and is attractive in appearance. It deserves, and will undoubtedly acquire, a wide distribution among American medical students.

Lewellys F. Barker.

Orchidaceæ: Illustrations and Studies of the Family Orchidaceæ, issuing from the Ames Botanical Laboratory, North Easton, Massachusetts. Fascicle I., by Oakes Ames, A.M. Boston and New York, Houghton, Mifflin & Co., The Riverside Press, Cambridge. 1905. Pp. viii + 156. Royal octavo.

From the preface we learn that the purpose of this work 'is to illustrate from type material, when possible, new or recently described orchid species, and species heretofore inadequately figured; to publish the original descriptions of all species so figured, with additional characterizations, full synonymy and geographical distribution; to furnish descriptions and descriptive lists of orchidaceous plants, which may prove useful in the study of regional floras; and to communicate the results of critical investigations among special genera.' This is certainly an ambitious undertaking, reminding us of a number of similar botanical projects undertaken during the last half-century, such as Gray's 'Genera' (1848–9); Gray's 'Forest Trees of North America' (begun in 1849, but never completed; published as a mere fragment in 1891, after the author's death); Goodale's 'Wild Flowers of America' (1879); Eaton's 'Ferns of North America' (1879–80); Sargent's 'Silva' (1891–1902) and Sargent's 'Trees and Shrubs' (1902–5). It is reassuring to know that the present undertaking is not dependent upon popular support, and that it is certain to have a reasonable permanence.

This fascicle includes descriptions and plates of five new and fourteen old species, a descriptive list of orchids collected in the Philippine Islands by United States Government botanists, a description and figure of a hitherto unrecorded orchid in the United States, and a paper entitled 'Contributions toward a Monograph of the American Species of Spiranthes.' We note with pleasure that all new descriptions are in Latin, as recommended several years ago by Professor Robinson as a corrective for the shocking illiteracy of some systematists. Following the Latin descriptions are somewhat more voluminous descriptions in English, followed by general notes, also in English. The plates are beautifully drawn, and illustrate the anatomical details with great clearness and fidelity.

The author shows a commendable conservatism in regard to specific distinctions, as is shown by the fact that he describes only five new species, all from the Philippine Islands, and also by his treatment of *Spiranthes,* in which he distinguishes thirteen species for all of North America north of Mexico. That this promises a reduction in the number of catalogued species in North America is suggested by the fact that in the last edition of Gray's 'Manual' (covering only the northern United States east of the 100th meridian) there are six species; in Britton's 'Manual' (covering but little more territory) eight; and in Small's 'Flora of the Southeastern United States,' sixteen.

In regard to nomenclature the author says, 'the first specific name of each species under the correct generic interpretation, wherever this could be determined with reasonable surety, or employed without leading to complications, has been revived.' While this is probably too lax an application of the law of priority, the carefulness of the author in verifying every citation and in studying herbarium material will enable every orchid student to make any corrections that might be necessary under a stricter construction. Taken all in all this work is one which must be very highly commended, and which all botanists who are interested in orchids must look upon as a welcome addition to botanical literature.

Charles E. Bessey.

The University of Nebraska.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for April has but two articles, an annotated list of 'Birds of the Isle of Pines,' by Outram Bangs and W. R. Zappey, and 'Studies on the Plant Cell—V.,' by Bradley Moore Davis, dealing with cell unions and nuclear fissions in plants.

The Zoological Bulletin for April tells of 'Further Improvements at the Aquarium' and of 'Photography at the Aquarium,' this being illustrated by many reproductions of photographs of fishes, that of the large spotted moray being particularly good.

The Museums Journal of Great Britain has articles on 'The Relationship existing between Statue and Pedestal in Classical and Renaissance Times,' 'Educational Museums as Schools' and 'The Management of National Museums.' In the 'General Notes' is noticed the gift to the British Museum of a collection of 10,000 specimens of eggs of Palæarctic birds, and to the United States of the collections of etchings and paintings by Whistler, presented by Charles L. Freer, of Detroit. As the United States is the only great nation without a picture gallery it will be interesting to see what disposition will be made of this collection. The sale of a mounted specimen of great auk to an American museum is recorded, the price being £450, or about $2,200. This is the highest price ever paid for a specimen of the great auk.

The Popular Science Monthly for May contains:

E. Rutherford: 'Present Problems of Radioactivity.'

Frank Waldo: 'The Harvard Medical School.'

A. D. Mead: 'Alpheus Spring Packard.'

Wm. E. Ritter: 'The Organization of Scientific Research.'

T. H. Morgan: 'The Origin of Species through Selection contrasted with their Origin through the Appearance of Definite Varieties.'

Edward S. Holden: 'Galileo,' continued from the February number.

Charles E. Bessey: 'Life in a Seaside Summer School.'

The Museum News for April contains a number of short articles referring to exhibits recently added to the collections of the Museums of the Brooklyn Institute.

SOCIETIES AND ACADEMIES.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 401st regular meeting of the Biological Society of Washington was held April 8, 1905, with President Knowlton in the chair and 43 persons present.

The first paper of the evening was by Professor W. P. Hay, on 'A Class of Arthropoda New to the District of Columbia.'

The paper began with a brief description of a new species of *Macrobiotus,* a genus of *Tardigrada,* discovered in December, 1904, in an aquarium at Howard University. Attention was called to the fact that this is the first record for the genus and class for the District of Columbia and the third for North America. This was followed by remarks on the structure of the tardigrades, their distribution and classification.

Although these animals have been shifted about from place to place until they now are regarded by most as Arthropoda, rather more closely related to the Arachnida than any other group, it was pointed out that such a disposition of them is incorrect. Except in number of appendages they show no resemblance to the Arachnida, nor can they be approximated to any other arthropodan group unless it be the Onychophora. Their relationship with the latter, even, is very distant, and in spite of the small number of species the Tardigrada should stand by themselves as a distinct class. It even may be necessary to place them alone in a distinct phylum as the supposed presence of segmented appendages in the genus *Lydella*, and the general possession of what are regarded as Malpighian glands only entitles them to a position among the Arthropoda.

In the second paper Mr. Wilfred H. Osgood discussed the characters and relationships of an 'Extinct Ruminant related to the Musk-Ox.' A specimen of a nearly perfect skull found in the Klondike gravels near Dawson, Yukon Territory, appears to represent an animal somewhat similar to the recent musk-ox (*Ovibos*) but generically distinct from it. It is evidently congeneric with *Ovibos cavifrons* of Leidy. The specimen, however, is much more complete than the remains studied by Leidy and presents many characters hitherto unsuspected. The animal was apparently larger than *Ovibos;* the general contour of the head was very different; and the horns, though directed downward, were more slender at the base and more divergent at the tips. The teeth were very large, even larger than those of the American bison (*Bison bison*), and were in fact more similar to those of the bison than to those of the musk-ox or the sheep. None of the characters suggest any connection with the sheep, but some of them might be taken to indicate relation to the bison, oxen, etc. There are, however, reasons for supposing that the present musk-ox has descended from an ancestor farther removed than either the oxen or the sheep.

That the extinct form bears an ancestral relation to the recent musk-ox, there can be little doubt. Interesting in this connection is the fact that some of the characters in the adult fossil form are found in the recent form only before it has reached maturity.

The third paper was by Dr. Barton W. Evermann, on the 'Trout of the Kern River Region.' This paper was illustrated by watercolors, proofs (in color) and lantern slides. Dr. Evermann said:

The Kern River flows nearly due south through a deep canyon with abrupt walls several hundred feet high. The tributary streams from the east as well as from the west flow across the high mountain plateau in a relatively gentle course, then drop in one or more considerable falls from the high plateau to the floor of the Kern canyon. These falls are at present usually so great as to form impassable barriers to the ascent of fish, and as a result many of the streams are wholly without fish of any kind. But in others, as Volcano Creek, Soda Creek, Coyote Creek and others, trout found their way and subsequently the falls became greater and the trout became isolated. In this way, although originally peopled from Kern River, each of many of these smaller streams came to have in it a colony of trout wholly segregated from all other trout and in time the trout of each of these streams became differentiated and now can be readily distinguished from those of other streams. Among those which are best differentiated are those of Volcano Creek, South Fork of Kern and Soda Creek. These must be regarded as three distinct species, only one of which has as yet been named.

E. L. Morris,
Recording Secretary.

THE CLEMSON COLLEGE SCIENCE CLUB.

The fifty-second regular meeting was held on February 17, at 8 p.m. Professor T. G. Poats presented a paper on 'Radium and Radioactive Substances' which was extensively illustrated by lantern slides, exhibition of the minerals which are the sources of radioactive substances, and by the spinthariscope.

The research paper by Professor C. E. Chambliss, 'Notes on the Rhinoceros Beetle,' was read by title.

The fifty-third regular meeting was held on March 24, at 8 P.M. Professor S. W. Reaves presented a paper on 'The Problem of the Duplication of the Cube.' Dr. F. H. H. Calhoun gave a report upon 'The Origin of the Mont Pelée Mud Flow.' A careful examination of the dust comprising this flow showed that it had been formed by the grinding of crystal-bearing rocks at temperatures below the melting point. Volcanic dust usually consists of small isotropic glass particles with or without a small per cent. of crystalline material. The particles in the flow from Mont Pelée were crystalline, broken, and some of the quartz crystals showed the wavy extinction due to strain. This of course may have been developed in the original rock mass instead of at the time of the formation of the dust itself. The following minerals were recognized in the dust: quartz, feldspar, hornblende, mica, an opaque iron mineral, and a pyroxene. The crystals were so shattered and strained that accurate determination was impossible.

Informal communications were presented on 'the tantalum lamp,' 'life and work of Professor A. S. Packard,' and 'the engineering problems involved in the raising of the Maine' by Professors W. M. Riggs, Haven Metcalf and P. T. Brodie, respectively.

HAVEN METCALF,
Secretary.

DISCUSSION AND CORRESPONDENCE.

SUGGESTIONS TOWARD A PHYTO-GEOGRAPHIC NOMENCLATURE.

THE terms formation and association are, perhaps, now used by most plant ecologists and geographers with something like scientific exactness. The word *formation* suggests the idea of an area of vegetation of a character marked enough to be essentially different from contiguous areas, the prominent forms of vegetation in this area having the same general aspect and adaptations corresponding with distinct physiographic positions. Such formations do not show an even mixture of plants, because such plants are collected into definite groups, or societies dependent somewhat upon the general conditions of the environment, but more especially because of the influence of historic or edaphic factors. Such assemblages of plants are called properly *associations.* The members of the association are looked upon as *vegetation forms.* The term *facies* is also a phytogeograpic concept, happily used with scientific accuracy. But the term *zone* is used somewhat loosely for very different ideas. The word is used in a latitudinal or climatic sense, and we speak of temperate and tropic zones. It is used for the areas at different elevations on the mountain side, hillside or bluff face. Again it is used to denote the arrangement of marine algæ on the sea coast, or for the concentric growth of aquatic plants about the lagoon of a pond or lake.

Humboldt (1805) applied the word zone to the vegetation, the distribution of which was determined by latitude. Schouw (1823) followed Humboldt and Bonpland in the use of the word in the latitudinal sense, and Kabsch (1855) also. It seems then that the word should be used in the restricted sense of a particular portion of the earth's surface determined by referring its position to the parallels of latitude. The concept of bands of vegetation on the mountain side, hillside or bluff face with respect to the altitudinal distribution of plants is best preserved by the use of the word *belt,* and we would speak of forest belt, subalpine belt, alpine belt, and where necessary this application could be extended to zonation on a bluff face. This usage is suggested, notwithstanding the importance of emphasizing the identity of zonation due to climate and that due to altitude, because for practical reasons the two ideas must be kept distinct. The writer wishes to suggest for the concentric bands of vegetation at times so clearly marked in lakes or pond, the term *circumarea,* for in mathematics, circumarea is the area of a circumscribed circle. We might then speak of a water-lily circumarea, a cat-tail circumarea, a shrubby circumarea. To express the submerged zonation on the sea coast, the English word *shelf* can be used. This is authorized by everyday speech, for we refer to a shelf of rock, a continental shelf, or a shelving beach. To speak of the marine shelves, *i. e.*, the *Fucus* shelf, the *Laminaria* shelf, would be to use the word with exactness. For the zonation of a beach, strand, river shore or prairie edge, the writer suggests the word *strip*. We should then speak of the shrubby strip, the grassy strip, the forest strip, etc. The idea of zonation on a river island, where the vegetation of a particular band runs completely around the island, and not continued lengthwise, as the word strip implies, the term *girdle* could be used. For forest zonation, where it is vertical, the term *layer* (stratum), or story ought to be accepted.

These terms are proposed because it seems to the writer that as the time approaches for the convocation of the Botanical Congress at Vienna in June, a full ventilation of nomenclatorial views should be made, not only for discussion, but also as suggestions to those who will take part in the deliberations of the congress.

John W. Harshberger.
University of Pennsylvania.

SPECIAL ARTICLES.

ON THE HABITS OF THE GREAT WHALE SHARK (RHINEODON TYPUS).

One of the most interesting of fishes and by far the largest of all is the *Rhineodon typus* (better known by the later name *Rhinodon typicus*). This has received the quasi-vernacular name whale shark, although, under the native Indian name (Mhor) it has been the object of a regular fishery for a long time along the northwestern coast of India (Sind). One might naturally suppose that the animal was so rare that nothing was known of its range or habits if the most recent works, popular as well as scientific, were consulted, but really, scattered through various volumes, many data may be found. A gentleman desirous of learning the history of the fish was unable to find data I informed him about, even after I had told him in what periodicals they were published. I, therefore, found them for him, and the difficulty that had been experienced by him, and may be by others, leads me to summarize the information that may be gleaned.

The species was first named *Rhineodon** *typus* by Dr. Andrew Smith in 1829, in the *Zoological Journal*, and the genus was adopted by Bonaparte in 1832 in the *Giornale arcadico di Scienze*, etc. (vol. 52). The numerous subsequent modifications of the name and notices of the species do not demand consideration in this place.

In 1850 an article, 'On Shark Fishing at Kurrachee' was communicated by George Buist to the *Proceedings of the Zoological Society* (pp. 100–102) and in it is an unmistakable reference to the whale shark, but which has been overlooked and not identified by Indian or other zoologists. From this and other recent sources the following account is compiled.

* * * * * * * *

The greatest—the most gigantic—of the sharks is one not uncommon in the Indian Ocean, but which, on account of its huge size, is represented by remains in very few museums and is little known. It is the *Rhineodon typus*, the type not only of the genus *Rhineodon*, but of an independent family—Rhineodontids; the not inappropriate name whale shark has been coined for it.

The whale shark is a huge animal occasionally, it is said, attaining to a length of sixty feet, although the average size is much less; it may be considered a pelagic species, not willingly often approaching land. It is a slow, apathetic animal, mostly living near the surface of the ocean and often resting, idly floating along and supposed to be 'sleeping.'

Its gigantic size is in inverse ratio to its food. Unlike the giant *Carcharodon* or maneater, it has extremely small teeth and its food consists of very minute animals. Its teeth, indeed, are quite similar (in a general way)

* The generic name was misprinted *Rhincodon* —evidently a typographical error.

to those of a skate (*Raia*), almost immovable, in many transverse rows, and with acute backward-directed points and bulging heel-like bases. It has a straining apparatus, somewhat like that of the basking shark (*Cetorhinus maximus*) and its food is analogous to that of its northern relative. It consists of the minute copepod and other crustaceans as well as mollusks which live about the surface of the ocean. These flourish in such abundance as to compensate by their number for their small size. In fact, like those other giants of the sea, some of the whale-bone whales, it finds enough for growth and the enjoyment of life among the smallest of animals.

Nothing is known of its reproductive habits but it has been assumed that, like its nearest relatives, it is ovoviviparous.

According to E. Perceval Wright, 'it is quite a harmless fish, with a mouth of immense width, furnished with small teeth,' really very minute. "It now and then rubs itself against a large pirogue, as a consequence upsetting it, but under these circumstances, it never attacks or molests the men, and while it reigns as a monster among the sharks, is not, despite its size, as formidable as the common dog-fish"—save in the line of upsetting!

Dr. Buist, as early as 1850, referred to it as the 'mhor or great basking shark' and stated that it was frequently captured at Kurrachee (not far from the mouth of the Indus). "It is found floating or asleep near the surface of the water; it is then struck with a harpoon." The stricken fish is "allowed to run till tired; it is then pulled in, and beaten with clubs till stunned. A large hook is now hooked into its eyes or nostrils, or wherever it can be got most easily attached, and by this the shark is towed on shore; several boats are requisite for towing. The mhor is often forty, sometimes sixty, feet in length; the mouth is occasionally four feet wide."

The later literature respecting the species has been already summarized in SCIENCE (1902, N. S., XV., 824–826).

THEO. GILL.

A FAUNAL SURVEY OF THE FOREST RESERVES IN THE SANDHILL REGION OF NEBRASKA AND OF THE LAKES IN THAT REGION.

NEBRASKA is, from a faunal standpoint, one of the most interesting states in the Union. Owing to its geographical location, to a range in altitude of from 810 to 5,300 feet, to variations in soil, climate and vegetation, the state contains a fauna rich in species and in great variety. Along the Missouri River, which forms the eastern boundary of the state, and following westward out the tributary streams into the prairie region, is a growth of purely deciduous timber representing species of trees derived from the south and east and including oaks, hickories, walnut, butternut, honey locust, Kentucky coffee-tree, wild cherry, etc.; while spreading into the state from the north and west and following down the Niobrara River nearly to its mouth is a growth of pine, together with quaking aspen, balsam poplar, mountain maple and black birch.

Midway across the state and at an average altitude of 3,000 feet lies a region of extreme interest, one of sandhills, varying in height up to 250 feet, so thickly scattered as to make a surface as rough as can well be imagined. The region is sharply defined. Streams flow out of it toward the east and south which have carried away sand to deposit it as sandbars lower down their courses, making in that way valleys running back into the hills and up which extend fringes of low trees and shrubbery, the advance guard of the tree growth from the southeast. To the north and west of this region are plains cut into by pine-clad canyons. In the sandhill region proper, however, no native trees of any kind are found, although there are here and there patches of stunted bushes—sand cherry, plum, rose, *Ceanothus* and June berry. Throughout this area, which in extent equals one fifth the total area of the state, or about 11,000 square miles, forest conditions are quite absent and forest animals absolutely lacking.

In this region the government has recently set aside two tracts of land as forest reserves. One, known as the Dismal River Reserve, in Thomas County, has an area of 86,000 acres, the other, the Niobrara Reserve, in northern

Cherry County, an area of about 126,000 acres. It is the intention to plant pines upon the hills and deciduous trees in the valleys, hoping thus to prove the possibility of foresting the sandhills and to induce private parties following its lead to aid the government in the work of reclaiming this region. The writer believes that here is a unique opportunity to study the development of a forest fauna from the beginning. These planted forests are by far greater in area than any forests ever planted before, and in them will be seen the gradual evolution of forest conditions, and, it may be assumed, the gradual development of a forest fauna, where absolutely no trace of such a fauna is to be found at the present time. The question suggests itself at once as to the possible origin of this fauna. Will it be derived from the pine-clad canyons of the north and west or will it come from the deciduous timber of the south and east? Will the pine growth receive its fauna from one direction and the deciduous forest in the valleys its from the other? If so, what will be the ultimate result? What will be the order of appearance of these forms and what will be the possible succession of dominant types which may exist one after the other in the evolution of this fauna from year to year? These are only a part of the problems that present themselves, the working out of which will be the labor of many years. During the past three years the author has been studying all of the conditions as they now exist in order to thoroughly familiarize himself with the ground, that the investigation may be followed through intelligently from the very beginning. How soon results may be attained and how important they will be the future must disclose.

Bound up in the study of the sandhill region and its fauna, though not directly connected with the investigation above outlined, is another problem which the author is also studying at the same time. In this region are many bodies of water differing in size, from mere pools to lakes even four or five miles in length, most of them fed from subterranean streams and with no outlet, lying in pockets between the hills. These vary from those containing the most beautifully clear, limpid, sweet water, full of animal and vegetable life, to those so strongly alkaline as to be incapable of supporting more than a limited fauna and flora and that made up of a very few species. The study of the distribution of life in lakes so widely different in chemical composition of the water, but in every other respect absolutely similar, promises extremely interesting results, not the least important of which will be the possible variation of the same species under these varying degrees of alkalinity.

It is three years since these investigations were begun. The first of these years was spent in a general survey of the region and in mapping the largest group of lakes, the second and third in a more critical study of lake conditions, the collecting of material, and the securing of a series of photographs. The work is to be continued during the present summer by the taking of water samples from as many lakes as possible for chemical analysis, by further study of the conditions in the lakes themselves and of the biological conditions in the region as a whole, and in the securing of additional photographs to illustrate them. The investigation is being carried on very largely at private expense, since there is no fund available in the state for the purpose; but the intention is to spend as much time as possible each year in the field, results being published from time to time as they may become complete so far as any given problem is concerned, or whenever the progress of investigation makes it possible to present definite results.

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THE MAILED CATFISHES OF SOUTH AMERICA.

In the *Transactions* of the Zoological Society of London, Volume XVII., Part III., October, 1904, C. Tate Regan publishes a 'Monograph of the Fishes of the Family Loricariidæ.' The Loricariidæ are one of the families of Ostariophysi. They are found only in the rivers of South America, ranging from Panama to Montevideo. As understood by Regan the Loricariidæ are equivalent to the Loricariidæ and Argiidæ of Eigenmann.

They are characterized by their reduced maxillary, the absent symplectic and suboperculum, the union of supraoccipital and parietals to form a single parieto-occipital bone, the absence of parapophyses, the sessile ribs and the compressed caudal vertebræ. All but the Argiinæ are covered, in part at least, by bony plates.

Mr. Regan's paper is based on the material in the British Museum and the Paris Museums and the types in the Harvard collections. A total of 189 species are recognized, thirty-four of which are described as new.

The genera and sometimes the species are found widely distributed; two of the genera, *Chætostomus* and *Arges,* are confined to the Andes of Peru. A table gives the known geographical distribution of all the species. In this table the following systems are considered as units: (1) Western coast-streams of Peru and Ecuador; (2) Rio Magdalena system (with Panama); (3) Venezuela and Guiana; (4) Upper Amazon (the Amazon and its tributaries above its junction with the Yapura); (5) middle and lower Amazon; (6) Rio Paranahyba and Rio San Francisco and their tributaries, and smaller coast streams in their neighborhood; (7) Rio Parahyba, Rio Grande do Sul and other coast streams of southeastern Brazil; (8) Rio de La Plata and its tributaries.

Little need be said of this classification except that it has long been known that Rio Grande do Sul should be classed with the Rio de La Plata and that the coast streams from Rio de Janeiro to Bahia form a natural unit distinct from the rivers to the north or south. About fifty genera that are found both in the Amazon on the north and the La Plata on the south are absent from this area. The Rio Paranahyba should probably be classed with the Lower Amazon. The Pacific slope of Panama should be classed with western Peru and Ecuador. The number of species in these systems is, respectively, 15, 18, 35, 64, 42, 17, 29, 32. Approximately one third of all the species are found in the upper Amazon, while but half as many are found in the vast La Plata Basin.

Brief chapters on sexual differences and changes during growth introduce the systematic portion of the paper. The systematic paper makes a distinct advance over the last revision of this family by Eigenmann and Eigenmann* in so far as Regan takes into consideration the details of the skeleton of the various groups, and inasmuch as he had a much more abundant material, especially of the species grouped by Eigenmann under the generic names *Hemiancistrus* and *Chætostomus.*

Considerable difference exists between the two papers on account of the estimate placed on the importance of some characters. Regan accepts fewer genera.

For museum purposes and for purposes of general classification larger genera and fewer names are preferable, but for all more intimate discussions of variation, geographical distribution and genetic origin of faunas smaller units are vastly preferable. Regan's species are also museum species with little recognition of the biological significance of varieties. For instance, Eigenmann and Eigenmann accepted the *Plecostomus affinis* of Steindachner as a variety of *commersoni* (not of Val.) = *punctatus.* The parent, or type form, is from Rio Janeiro, Santa Cruz, Macacos, Itabapuana, Rio Parahyba, the variety *affinis* from Rio Janeiro, Mendez, the rios Mucuri, Parahyba, Muriahe, Doce and San Antonio. The variety *affinis* is more abundant than *punctatus,* 'over 50 specimens having been examined ranging from .13–.26 m.' A second variety was described, three specimens .30–.35 m., from São Matheos. Of these varieties Regan says:

> These varieties [based in one case on over fifty specimens] scarcely seem worth recognition; in all young specimens the spots are large and the lower surface of the head and abdomen partially naked, and the persistence of these features in the adult must be regarded as cases of individual variation only.

Of *Plecostomus lima atropinnis* Regan says: Eigenmann has given the name *P. lima atropinnis* to a specimen (presumably of this species) from Goyaz, with the fins uniformly

* 'A Revision of the South American Nematognathi,' Occasional papers, Cal. Acad. Sci., I., pp. 1–508, 1890.

dark brown." Regan considers this variety distinct from *lima* and names it *garmani*. Of course, if the variety *atropinnis* is distinct from the parent form it must go by the older name *atropinnis* and not *garmani*.

Eigenmann's genus, *Loricaria*, is divided as follows:

I. Teeth in the jaws in small or moderate number, not setiform; a more or less distinct orbital notch.
  a. Snout rounded or pointed, not or not much, produced .... *Loricaria*.
  aa. Snout produced with a long rostrum, *Hemiodontichthys*.

II. Teeth in the jaws numerous, setiform; orbit circular, without distinct notch.
  b. Dorsal opposite to the ventrals. *Oxyloricaria*.

Admitting that group I. is distinct from group II. there is no reason why the second group should not also be divided as group I. is, and, indeed, Regan does divide it as follows, but does not use generic or subgeneric names to designate the divisions:

b. Snout rounded or pointed, not produced as a rostrum.

bb. Snout produced, forming a distinct rostrum; sides of the head in the male, margined with bristles.

The group under *b* contains the type of Steindachner's genus *Harttia;* the second is the *Sturisoma* of Swainson.

The *Hemiodontichthys* of Regan contains two distinct generic types, the one with the snout expanded at the tip (the *Hemiodontichthys* of Bleeker), and the other with the snout simply pointed (the *Hemiodon* of Bleeker). *Hemiodon* being preoccupied, this genus may be termed *Reganella,* in recognition of this author's invaluable services in reviewing the group.

Arranging the respective genera or subgenera as far as possible opposite each other, a comparison of the results of Eigenmann in 1890 and of Regan in 1904 gives us the following.

Families and Subfamilies. Genera. Subgenera.	No. of Species.	Families and Subfamilies. Genera. Subgenera.	No. of Species.
Argiidæ.		Argiinæ.	
Arges,	4	*Arges,*	19
Cyclopium,	2		
Astroblepus,	1	*Astroblepus,*	1
Loricariidæ.		Loricariidæ.	
Loricariinæ.		Loricariinæ.	
Farlowella,	6	*Farlowella,*	7
Hemiodontichthys,	1	*Hemiodontichthys,*	2
Loricaria,	30	*Loricaria,*	40
Hartia,	1	*Oxyloricaria*	10
Oxyropsis,	1		
Hypoptopominæ.		Hypoptopomatinæ.	
Hypoptopoma,	3	*Hypoptopoma,*	6
Hisonotus,	1		
Parotocinclus,	1		
Otocinclus,	2	*Otocinclus,*	9
Plecostominæ.			
Microlepidogaster,	1		
		Neoplecostominæ.	
Neoplecostomus,	2	*Neoplecostomus,*	1
		Plecostominæ.	
Plecostomus,	24	*Plecostomus*	26
		(*Plecostomus* 21)	
Rhinelepis,	4	(*Pogonopoma* 3)	
		(*Rhinelepis* 2)	
Cochliodon,	1	*Panaque,*	4
Panaque,	3		
		Pseudacanthicus	
		Ancistrus,	31
Hemiancistrus,	18	(*Lasiancistrus* 4)	
Pterygoplichthys,	8	(*Ancistrus* 18)	
Parancistrus,	3	(*Parancistrus* 3)	
Pseudancistrus,	5	(*Pseudancistrus* 6)	
Delturus,	2		
Hemipsilichthys,	1	*Hemipsilichthys,*	1
Acanthicus,	2	*Acanthicus,*	1
Chætostomus,	20	*Chætostomus,*	15
Ancistrus,	8	*Xenocara,*	12
Total,	155		189

Unfortunately there is nowhere in the paper any indication what species were used as the types of old or of new genera to help future reviewers and similarly there is nowhere with the synonymy and bibliography any indication of the locality from which species were recorded to help future students of geographical distribution.

The rules of nomenclature adopted differ in principle from American usage. The first species, the well-known *Plecostomus plecostomus* Linnæus, appears by the later name, *P. guacari* Lacépède. *Cochliodon* Kner is rejected apparently on account of the use of *Cochlodon* D'Orbigny, while *Trichomycterus* is used, although it is a misspelling merely of *Thrichomycterus,* which is another genus. *Cyclopium* Swainson is rejected because 'his generic name, being derived from the genitive plural of *Cyclops,* is as inadmissible as would be that of *Silurorum.*' *Oxyloricaria* is used because the older *Sturisoma* is a 'nomen hybridum.' The writer would be very glad to be able to take back and make over the inelegant, barbarous or otherwise objectionable names he has inflicted upon respectable fishes, but, with his American confreres, he abides by the rule, both for himself and for others, that a name is a name no matter by whom conferred or however wonderfully made. How dangerous it is to deviate from this rule is made evident by the fact that no less a classical scholar than Regan himself has mistaken the neuter adjective *Cyclopium* for the genitive plural of *Cyclops*. If, as Regan thinks, *Cyclopium* is not generically distinguishable from *Arges*, all the species should go by the older name *Cyclopium*.

The reason for shifting the name *Ancistrus* from *cirrhosus* as the type are not apparent and should have been distinctly stated. The name *Ancistrus* was proposed by Kner (Hypostomiden 272, 1853) for the following described species and one of them must be considered the type:

(*a*) Brachypteri: (1) *cirrhosus*, (2) *dolichopteri*, (3) *gymnorhynchus*, (4) *mystacinus*, (5) *pictus*, (6) *brachyurus*, (7) *scaphirhynchus*. To these described species Kner adds *medians* and *itacua*. Of *mystacinus* he says: "Diese Art scheint dem *Hyp. guacharote* Val. sehr nahe zu stehen, doch lässt sich bei der Ungenauigkeit der Beschreibung des letzten über die etwaige Gleichartigkeit beider nich sicher entscheiden."

(*b*) Macropteri: (1) *duodecimalis*, (2) *longimanus*, (3) *gibbiceps*, (4) *litturatus*.

It is to be emphasized that *guacharote* was known to him only from a description, considered too general for specific distinctions.

Gill ('Synopsis of the Freshwater Fishes of the Island of Trinidad,' 47) amended the genus *Ancistrus* by separating the species of group (*b*) under the new name *Pterygoplichthys*, saying: "The genus *Ancistrus* seems to have been framed with especial regard to those fishes to which the name is here restricted, and is by Dr. Kner divided into two sections, which correspond to *Ancistrus* and *Pterygoplichthys*, his section '*a*' answering to the former genus, and '*b*' to the latter." A more definite restriction to the species described by Kner could not be desired. The *Ancistrus* of Gill is identical with section '*a*' of the *Ancistrus* of Kner. Gill described some specimens from Trinidad as *Ancistrus guacharote* Val. This is the first formal introduction of *guacharote* to the genus *Ancistrus*. But Günther later maintained that the *guacharote* of Gill is not that of Valenciennes and named the former *trinitatis*. Regan has been unable to decide whether *trinitatis* is distinct from *guacharote* or not; nevertheless, it appears that on the fact that Gill described *guacharote* Regan has selected the latter as the type of the genus *Ancistrus*. Gill did not formally select *guacharote* as type, and if any inference is permitted it must certainly be that the first species described by Kner, *cirrhosus*, is the type—certainly not the *guacharote* or *trinitatis*, which was unknown to Kner. However, neither Kner nor Gill specifically indicated a type. Bleeker* formally selected *cirrhosus* as the type, and there seems to be no reason why *cirrhosus* should be placed anywhere than in the genus *Ancistrus*. Nevertheless, this species is placed in a new genus, *Xenocara*. *Guacharote*, on the other hand, is placed in the genus *Ancistrus*, and strange enough in a new subgenus, *Lasiancistrus*. There may be reasons for the ruling in these premises but they are not evident from a perusal of the paper. Regan's name *Xenocara* may be retained for those of the Ancistroids without tentacles.

Regan's monograph is so welcome a contribution and so enthusiastically conceived and executed that it is ungracious to differ with the author in the minor points indicated.

C. H. EIGENMANN.

CURRENT NOTES ON METEOROLOGY.

KITE-FLYING AT SEA: RECENT RESULTS.

THE results obtained by means of kite-flights from the Prince of Monaco's yacht during the summer of 1904 are discussed by Professor Hergesell in the *Comptes rendus*, Vol. CXL., p. 331. Twenty-five ascents were made, eight in the Mediterranean, one in the Baltic and sixteen in the Atlantic. In the region of the trades the adiabatic gradient, of 1° in 100 meters, is always found in the lowest strata, and is even exceeded, the thickness of this stratum being between 100 and 600 meters. The relative humidity rises from 70 per cent. or 80 per cent. at sea level to 95 per cent. or 100 per cent. Above this stratum the temperature rises quickly several degrees, and the humidity

* *Nederl. Tijdschr.*, I., 1863, 77.

diminishes suddenly to below 50 per cent. The temperature continues to rise through a stratum sometimes 1,000 meters in thickness, and the humidity decreases to 10 per cent. or 20 per cent. Above this stratum the adiabatic rate is again met with, but the humidity is low. The northeast trade, with a velocity of about sixteen miles an hour, prevails at sea level. At greater altitudes the wind shifted gradually through north to northwest, and in two instances through east to southeast and south. No southwest current (anti-trades) was shown by the kites. The northwest or southeast winds in the highest strata had a velocity not over seven or nine miles an hour. In the intermediate strata the velocity was generally even lower (*Nature,* March 16, 1905, 467; *Ciel et Terre,* March 16, 1905, pp. 47–49).

MOUNTAIN SICKNESS.

In an account of 'Five Ascents to the Observatories of Mont Blanc' (*Appalachia,* Vol. X., No. 4), Mr. A. L. Rotch describes his different experiences, and pays special attention to the physiological effects of the high altitudes. On the first ascent, at a height of 14,320 feet, where the night was spent, the author suffered with this most distressing malady, but was afforded some relief by breathing oxygen. In the morning he was well enough to aid in setting up the barometers and to undertake preliminary spectroscopic observations. Another night, spent at the Vallot cabin, 1,460 feet below the summit, was also made unpleasant by a repetition of the discomforts of mountain sickness. On a second expedition oxygen failed to give any relief, but some alleviation was obtained by the use of phenacetine. The third ascent was marked by suffocation and dizziness during the night spent at the Grands Mulets shelter, the pulse rising to 100, the altitude being comparatively low. Mr. Rotch attributes these symptoms to a large quantity of quinine which he had taken before starting. On the further climb, great difficulty was experienced in walking, and there was hardly strength enough, at the Vallot Observatory, to gather up the sheets of the recording instruments. A fourth ascent was accomplished without difficulty, the author being 'in prime condition' on the summit.

MONTHLY WEATHER REVIEW.

The November number of the *Monthly Weather Review* (dated January 31, 1905) contains the following articles of general scientific interest: 'Airy's Theory of the Rainbow,' by Rev. D. Hammer, S.J.; 'Radiation in the Solar System,' being an address delivered before the British Association by Professor J. H. Poynting; 'A Simple, Effective and Inexpensive Lightning Recorder,' by H. F. Alciatore; 'An Honest Long-range Forecaster,' 'Meteorological Course at Williams College,' 'Meteorology in New South Wales,' 'Deflection of Thunderstorms with the Tides,' 'A Proposed International Contest of Weather Forecasters.'

FLOODS IN THE SAHARA.

Occasional sudden downpours of rain, somewhat similar in character to our western cloudbursts, occur in the mountains of the Saharan region, causing floods, and even loss of life. On the evening of April 12, 1899, near Berrian, 300 miles south of the city of Algiers, a flood of this character swept down the usually dry bed of a wady, and caused the death, by drowning, of some French soldiers who were encamped in the bed. A recent case of the same kind is reported in the *Bulletin* of the *Comité de l'Afrique,* No. 11, 1904. On October 21 the village of Aïn Sefra, in southern Algeria, on the edge of the Sahara, was overwhelmed by floods which suddenly rushed down two wadys. The floods were due to very heavy rains which had fallen on a neighboring mountain range. Ten Europeans and fifteen natives were drowned. The flood is reported to have subsided about fifteen minutes after reaching the town.

THE GUINEA CURRENT.

In 1895 there was published by the Meteorological Institute of the Netherlands a report entitled 'De Guinea en Equatoriaal Stroomen,' dealing with the currents, temperature, winds, specific gravity of ocean water, pressure, frequency of rainy days, etc., of the region between the equator and lat. 25° N., and between the meridian of Greenwich and long. 40° W. A new edition of these charts has now been issued ('Observations océanographiques et météorologiques dans la Région du Courant de Guinée,' 1855–1900. (1) Texte et Tableaux, pp. iv + 116, (2) Planches, VIII. Utrecht, 1904). R. DeC. Ward.

SCIENTIFIC NOTES AND NEWS.

Sir Patrick Manson has been invited to give the Lane lectures at the Cooper Medical College, California, this year. He will lecture on some aspect of tropical diseases.

Professor J. N. Langley, of Cambridge, will give one of the general lectures at the meeting of the Association of German Scientific Men and Physicians, which opens at Meran on September 24. His subject will be 'Recent Researches on the Nervous System.'

Lord Rayleigh is about to retire from the professorship of natural philosophy at the Royal Institution, which he has held for eighteen years. He will be made honorary professor. Lord Rayleigh has given twenty-three Friday evening discourses and twenty-one courses of afternoon lectures at the institution.

Lord Lister celebrated his seventy-eighth birthday on April 5.

Professor Eugene W. Hilgard, of the department of agriculture of the University of California, has been granted leave of absence for next year. Professor Hilgard, who is seventy-two years of age and has held his chair in Canfornia for thirty-one years, is privileged to retire with two thirds salary, according to the statutes of the university.

A marble portrait bust is to be installed at Brussels in honor of Dr. Beco, secretary-general of the Belgian Department of Public Health.

A gold medal in honor of Professor Pozzi, the eminent French surgeon, by the sculptor Chaplain, is to be presented to him by his colleagues and pupils.

The students of Jefferson Medical College will at the approaching commencement present to Dr. Forbes a life-size portrait of himself. Dr. Forbes has taught anatomy in Philadelphia for forty-nine years.

The health of Lord Kelvin is much improved and he was expecting to be able to leave London shortly for a change of air.

Professor H. E. Gregory, who has been ill with inflammatory rheumatism, has much improved, and expects to resume his university duties in the course of several weeks.

Sir Richard Douglas Powell has been elected president of the Royal College of Physicians in succession to Sir William Church.

Mr. John Gavey, C.B., engineer-in-chief to the Post Office, has been nominated for election as president of the British Institution of Electrical Engineers for 1905–6. Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, and Mr. J. E. Kingsbury, of the Western Electric Company, have been nominated for the office of vice-president.

Professor Thomas M. Gardner has resigned his chair in the faculty of mechanical engineering at Cornell University.

Mr. E. T. Newton, F.R.S., paleontologist to the British Geological Survey, retired on May 4, after forty years of service. He is succeeded by Dr. F. L. Kitchin.

We learn from *Nature* that the Baly medal, given every alternate year on the recommendation of the president and council of the Royal College of Physicians of London for distinguished work in the science of physiology, especially during the two years immediately preceding the award, has been awarded to Professor Pavlov, of St. Petersburg. The Bisset Hawkins gold medal for 1905, given triennially for work deserving special recognition as advancing sanitary science or promoting public health, has been awarded to Sir Patrick Manson, K.C.M.G.

The Jacksonian prize of the Royal College of Surgeons has been awarded to Mr. H. J. Patterson for his essay on 'The Diagnosis and Treatment of such Affections of the Stomach as are Amenable to Direct Surgical Interference.'

Dr. Nettie Maria Stevens, of San Jose, California, associate in experimental morphology at Bryn Mawr College, has been awarded the prize of $1,000 offered every two years by the Association for Maintaining the American Woman's Table at the Zoological Station at Naples and for Promoting Scientific Research by Women. This is the second award of the prize which is offered for the best thesis written by a woman on a scientific subject. Miss Stevens graduated from Stanford University in 1899, and received the degree of doctor of philosophy from Bryn Mawr College in 1903. During the past year she has held a Carnegie assistantship in addition to her position at Bryn Mawr. The thesis which won the prize is on 'The Germ Cells of the *Aphis rosea* and the *Aphis œnotheræ*.'

The Smithsonian Institution has made a grant of $250 from the Hodgkins Fund to Professor W. P. Bradley, of Wesleyan University, for an experimental study of the flow of air at high pressure through a nozzle. The subject of this investigation is of fundamental importance in connection with the usual method of liquefying air.

Dr. Raymond Pearl, instructor in zoology at the University of Michigan, has been granted leave of absence for a year. He will spend the year abroad, continuing his work on variation from the biometrical standpoint, having received a grant for this purpose from the Carnegie Institution.

Sir William Huggins, president of the Royal Society, made one of the speeches at the anniversary banquet of the Royal Academy of Arts, held on April 29.

Professor John Adams, head of the department of education of the University of London, is to deliver a course of lectures in the School of Education of the University of Chicago during the summer quarter.

Professor John Dewey, of Columbia University, lectured at Harvard University on May 5, his subject being 'Knowledge and Action.'

The following provisional program of public evening lectures at the Marine Biological Laboratory, Woods Hole, Mass., has been arranged; other lectures will be announced later:

June 30, Miss Adele M. Fielde, 'The Power of Recognition among Ants.'

July 5, Dr. A. J. Carlson, 'The Physiology of the Heart.'

July 7, Professor A. P. Mathews, 'The Chemical Basis of Life.'

July 12, Professor H. S. Jennings, 'The Behavior of Lower Organisms.'

July 14, Dr. R. M. Yerkes, 'The Behavior of Higher Organisms.'

July 19, Professor A. D. Mead, 'Some Observations on the Natural History of Marine Animals.'

July 21, Miss Katherine Foot and Miss E. C. Strobell, 'Maturation and Fertilization of the Egg of *Allolobophora fœtida*.'

July 26, Professor W. B. Scott, 'Miocene Ungulates of South America.'

A marble memorial of the late Professor Giulio Bizzozzero is to be placed in the Institute of General Pathology at Turin.

Dr. Joseph Everett Dutton died in the Congo on February 27 at the age of twenty-nine years. He was sent to Africa by the Liverpool School of Tropical Medicine to investigate trypanosomiasis and tick fever.

We regret also to learn of the death of Professor Otto Struve, director of the Poulkowa Observatory from 1862 to 1890, which took place on April 14, at the age of eighty-five years.

Plans have been filed for a fifteen-story building to cost $975,000, which Mr. Andrew Carnegie is to present to the Associated Societies of Engineers of New York. It is to be erected on the large plot from 25 to 33 West Thirty-ninth Street, and immediately adjoining it in the rear, facing at 32 and 34 West Fortieth Street, will be a thirteen-story club-house, which is to cost an additional $375,000, also part of Mr. Carnegie's gift.

M. Emmanuel Drake del Castillo has bequeathed to the Paris Natural History Museum a herbarium, a botanical library and the sum of $5,000.

The London *Times* says that an offer has been made by certain of the companies engaged in the production of phonographic records to deposit in the British Museum records of the voices of distinguished living men, and that the trustees have expressed their willingness to receive, under special restrictions and with very careful selection, such records, which will be for posterity only and will in no circumstances be available for contemporary use.

A geological excursion to Syracuse, N. Y., for the purpose of examining the glacial-marginal channels, first explained by Gilbert and later more fully described by Fairchild, was made on April 15–17; professors and students to the number of twenty-five from six institutions, Harvard, Colgate, Syracuse, Cornell, Rochester and Rutgers, participating. Professors Davis, Hopkins, Fairchild and Lewis were present. The weather was inclement, high wind with snow squalls blowing cold all three days; but the channels were of repaying interest. They were examined in three north-sloping spurs of the upland or plateau country, and found to recur repeatedly in systematic sequence; but the deltas expectably associated with them in the intermediate valleys seemed to be deficient in volume, as if much reduced by subsequent erosion.

It is stated in *Nature* that the president of the Board of Agriculture and Fisheries has appointed a departmental committee to inquire, by means of experimental investigation and otherwise, into the pathology and etiology of epizootic abortion, and to consider whether any, and, if so, what, preventive and remedial measures may with advantage be adopted with respect to that disease. The chairman of the committee is Professor J. MacFadyean, principal of the Royal Veterinary College.

The Congress on Quackery, which was to have been opened in Paris on May 8 under the presidency of Professor Brouardel, has been postponed till April 30, 1906.

Lieutenant Peary has chartered at St. John's the sealer *Erik* to convey coal and stores to Greenland and act as auxiliary vessel to his projected Arctic expedition.

The Boston Society of Natural History announces subjects for the two annual Walker prizes in 1906 as follows:

An experimental field study in ecology.

A contribution to a knowledge of the nature of competition in plants.

A physiological life history of a single species of plant.

Phylogeny of a group of fossil organisms.

A study in stratigraphy.

A research in mineral physics.

A study on entectics in rock magmas.

A study in river capture.

A region that is new to both geologists and topographers is described by Professor Israel C. Russell in a preliminary report on the geology and water resources of central Oregon, recently published by the United States Geological Survey. No description of the physical features, water resources or geology of this region is in print, and the only map that Professor Russell found available for use during his reconnaissance, which took place in the summer of 1903, was a map of the state of Oregon, drawn to a scale of 12 miles to the inch, published by the General Land Office. The route followed by Professor Russell and his assistants led from Burns, Oregon, westward through the western part of Harney County, across the southeastern and central portions of Crook County, by way of Prineville and Sisters, thence southward through the northwest portion of Klamath County to Fort Klamath, and thence westward across the Cascade Mountains to Medford, in Jackson County. The region examined includes the extreme northern part of the Great Basin (an area of about 210,000 square miles situated principally in Oregon, Nevada, Utah and southeastern California, from which no streams flow to the ocean) and a part of the drainage area of Deschutes River and of its principal tributary, Crooked River, which joins it from the east.

Dr. Joseph Hyde Pratt's annual report to the U. S. Geological Survey on the production of asbestos shows that the principal changes to be noted in the asbestos industry at the close of 1904 were the increase in the production in the United States of the amphibole variety, the development of the Grand Canyon chrysotile asbestos deposits, and the increase in the demand for the chrysotile variety. The many new uses which have been devised for chrysotile asbestos have created a demand for it that is now in excess of the supply. The high price which can be obtained for the chrysotile asbestos when it is in fibers of sufficent length for spinning permits the mining of this mineral in some places where the cost of mining would become prohibitory with any material decrease in price. One of the most interesting features of Dr. Pratt's report this year is a description of the results of certain experiments that have been made on asbestos building board by Mr. George F. Sever, of New York City, for the Keasbey and Mattison Company, of the same city. The tests were made on asbestos building lumber and magnesia building lumber and show conclusively that both these materials are superior to wood for the purposes for which they are manufactured, but that the asbestos lumber is much better than the magnesia. Such asbestos lumber, when employed in the construction of street railway and standard railway cars, for covering the end framing, should prevent the cars from taking fire by any derangement of the electrical apparatus. Another type of asbestos building material that is beginning to be extensively used is asbestos board or sheathing, for roofing and for side walls. An asbestos shingle recently patented by Messrs. Keasbey and Mattison is composed of asbestos fiber and hydraulic cement. These shingles are much stronger than slate and lighter in weight. They are made in three colors, gray, slate and tile red, in squares 4½ inches on a side, with two corners of the square truncated. The use of asbestos materials in building has been considered chiefly from the standpoint of fireproofing; yet there is another and perhaps as important a reason for their employment, and that is for preserving an even temperature in the building erected. Houses so built as to be surrounded by asbestos should be cooler in summer and warmer in winter than other houses.

UNIVERSITY AND EDUCATIONAL NEWS.

The McCormick family have added $1,000,000 to the endowment of the McCormick Theological Seminary of Chicago.

Mr. Andrew Carnegie has offered to give Radcliffe College $75,000 for a library building on condition that an equal sum be collected for its endowment.

Lord Curzon has laid the foundation stone of the Agricultural College at Pusa. This college and experiment station were made possible by a gift of $150,000 which Mr. Henry Phipps gave Lord Curzon to use for the good of the people of India.

Birmingham University has received £20,000 under the will of the late Mr. Thomas Best.

The Boston *Transcript* reports that the faculty of the Massachusetts Institute of Technology has adopted by a vote of fifty-seven to six a report adverse to the proposed alliance with Harvard University.

Dr. Julius Stieglitz, of the department of chemistry of the University of Chicago, has been appointed to a professorship of chemistry in that institution.

At the University of Colorado, Dr. M. E. Miles, who has been demonstrator of anatomy, has been appointed professor of anatomy; Dr. E. H. Robertson, professor of bacteriology and pathology, has resigned to engage in other work; and Mr. G. S. Dodds has been appointed instructor in zoology.

Mr. William E. Brooke has been promoted to an assistant professorship of engineering mathematics in the University of Minnesota.

Dr. J. Carlton Bell has been appointed instructor in experimental psychology in Wellesley College.

Mr. Stanley Dunkerley, M.Sc., head of the department of applied mathematics in the Royal Naval College, Greenwich, has been appointed professor of engineering in the University of Manchester.

At King's College, London, Mr. Peter Thompson, M.D., has been elected professor of anatomy; and Professor Arthur Dendy, D.Sc., South African College, Cape Town, has been elected professor of zoology.

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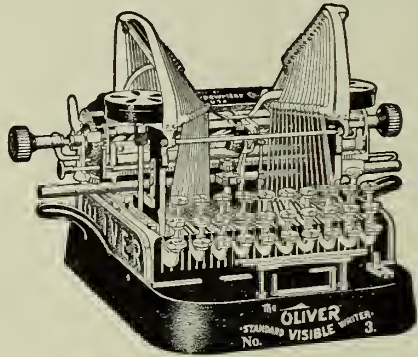

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FRIDAY, MAY 26, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held this year during Wednesday, Thursday and Friday of the second week in April. The sessions as usual were held in the rooms of the society in Philadelphia. The number in attendance, including nonresident members, resident members and others, was quite as large as on previous similar occasions, while the quantity and character of the papers offered, together with the discussion on them, called forth much favorable comment. The program was especially broad in its scope, including the various departments of natural and physical science, of literature and of problems in economics.

On Thursday the society sent, through its secretary, Dr. I. Minis Hays, a telegram of greeting to the University of Virginia on the occasion of the inauguration of a president of its faculty. This was done in special commemoration of the fact that Thomas Jefferson, the founder of the university, was also an early president of the American Philosophical Society.

The meeting was opened on Wednesday afternoon at 2:30 o'clock by the president, Vice-Provost Edgar F. Smith, of the University of Pennsylvania, with a brief address of welcome, after which the following papers were presented:

The Weal-Relation: Professor LINDLEY M. KEASBEY, of Bryn Mawr, Pa.

A Plea for Governmental Supervision of Posts Necessitating Normal Perception of Color: Dr. Charles A. Oliver, of Philadelphia.

The Present Status of the International Catalogue of Scientific Literature: Dr. Cyrus Adler, of Washington.

The Composite Character of the Babylonian Creation Story: Professor Morris Jastrow, Jr., of Philadelphia.

In the course of his address on 'The Composite Character of the Babylonian Creation Story,' Professor Jastrow referred to the progress made in recent years in the interpretation of the Babylonian creation tale, thanks chiefly to the discovery of new fragments of the story in the remains of the famous Assyrian library of Ashurbanapol, at Nineveh.

"We now know," he said, "that the narrative in the form of a poem consisted of about 1,000 lines, of which three fourths have been found. The version of the story which we have is the one that was produced in the city of Babylon by the priests of Marduk, the chief god of the later Babylonian Pantheon. This god is, therefore, introduced as the creator and as playing the principal part in the struggle between the gods and an army of monsters led by Tiamar.

"The 'Babylon' version of the creation story rests on an older tale, which originated in Nippur, and in which the chief god of that city, who was called Bel, is the hero. When the 'temple library' of Nippur shall be discovered, or if it has been discovered, we may expect to find this older version. At present we may conclude from the 'Babylon' version that an earlier 'Nippur' version existed. There was, however, also a third version, which originated in Eridu, one of the most ancient religious centers of Babylonia, and in which the god Ea played the chief rôle.

"In the 'Babylon' version the two older versions, that of Nippur and that of Eridu, have been combined to form the Marduk epic. Bel's name and rôle are transferred to Marduk, and, likewise, Ea's prerogatives. A trace of the three versions is to be seen in the opening lines, which designate three beings, all synonyms of one another, as the symbol of the water chaos which preceded the organization of the regular workings of nature."

The English Masque: Professor Felix E. Schelling, of Philadelphia.

The English masque is a by-form of the English drama which flourished between the years 1597 and 1658, and is absolutely definite in its nature and characteristics, and to be defined as that species of the entertainment, the nucleus of which is a dance. The masque was usually presented at court as the setting of a ball and the actors in its serious parts were the nobles and ladies attendant on royalty. The masque is based on the revels, disguisings and maskings popular in England and, especially at court, from time immemorial. It is in no wise a derivative in any essential feature of similar festivities of Italy or France; but was developed as a definite product of literary and histrionic art chiefly in the reigns of King James and King Charles I. Thomas Campion, the musician, and Samuel Daniel, the court poet, wrote its earliest forms; but it was perfected mainly in the hands of Ben Jonson, who added the antimasque, or contrasted comedy element; while Inigo Jones, the royal architect, brought its costuming, scenic features and mechanical devices for stage effect to a surprising degree of perfection. The list of less than sixty masques within this period is surrounded by many dramatic compositions of a character more or less similar. But even Milton's Comus, commonly designated a masque, is not, strictly speaking, such a production.

The distinguishing features of the masque were its allegorical presentation of matter supposedly fitting to the occasion; its lyrical poetry; its novel musical effects and combinations both vocal and instrumental, the gorgeousness and costly quality of its costuming; the ingenuity of its stage settings and mechanical devices for stage effect; its mingling in one performance, though in separate parts, the amateur with the professional actor; and scenes of comic relief offered in the antimasque performed by professional singers, dancers and players.

The Emancipation of the Waterways: Professor LEWIS M. HAUPT, of Philadelphia.

In his paper on the 'Emancipation of the Waterways,' Professor L. M. Haupt traced first the beneficial effects of improvements in the capacity of navigable channels in lowering the rates of freight, as for grain from Chicago to New York from 29.6 cents per bushel in 1866 to 4.7 cents in 1903, due to the enlargement of the Soo canal from 12 to 20 feet. He quoted Senator Frye to the effect that the saving on lake freights in one year was five times the total cost of the entire lake system, and estimated that the saving on the tonnage of 1903 was $194,660,408. He then showed the increased value to result to the western farmer by the proximity of navigable channels as illustrated in the lower prices received in Nebraska, Kansas and Missouri as compared with states nearer the seaboard, and that this difference was the cost of the overland haul. On cereals alone this charge amounted to a loss to Nebraska of over $14,000,000 as compared with prices in Kansas, a little nearer water rates. The policy of European countries owning railways was then stated to be a return to the rapid and extensive development of their canal systems to encourage the delivery of raw materials for manufactures in the competition for the world's markets as in France, Belgium, Holland, Germany, Russia, Austria, Italy, etc., where thousands of miles are under construction with improved hydraulic and electric lifts and with electric haulage, for barges of from 300 to 1,000 tons.

The decadence of and opposition to the canals in this country are shown in the abandonment of over 700 miles in Pennsylvania; 656 in Ohio; 269 in New York, etc.; and the effort now on foot in the latter state to prevent the enlargement of the Erie to even 12 feet, so as to retain some of the grain trade which must otherwise go to Canadian ports.

The great profit-earning capacity of canals under corporate control was shown in the case of the English and American canals which have been maintained, as compared with those managed by railways, which was stated to be due to the small cost of operation.

In 1835 there were 2,700 miles of canals in operation in the United States, but by 1889 it had fallen to 2,305 miles, while the railroads had increased in the same time from 1,000 to 158,000 miles, and were still opposing waterway legislation, although it was believed, in the speaker's opinion, to be the most beneficial auxiliary to the development of railway revenues, as shown by the stock quotations of the roads having deep-water competition.

The great pressure upon Congress, the shortness of the sessions and the enormous demands for enabling legislation which have been accumulating for years, in some cases more than a half century, lead to the conclusion that much more satisfactory results could be secured for the emancipation of our waterways by a return to the early policy under which they were developed by private or state control, locally, with powers to exercise the rights of eminent domain as is still done in the case of highways and railroads.

The Beginnings of Lumbering as an Industry in the New World: Mr. John E. Hobbs, of North Berwick, Me.

THURSDAY, APRIL 31.

Morning Session—10:30 O'clock.

President Smith in the chair.

The Structure of the Lignified Cell Wall: Professor John M. Macfarlane, of Lansdowne, Pa.

The lignified cell wall has been regarded as built up of a series of lamellæ deposited from without inward on the primary cellulose membrane, all of the lamellæ being in direct contact with each other. The stratified appearance has been explained by Hanstein, Strasburger and others as due to 'water-poor' and 'water-rich' layers.

From a study of numerous types of indurated element drawn from many of the vascular plants, the speaker stated that he regarded the lamellæ as quite distinct from each other, and separated by spaces usually as wide as the lamellæ themselves. The aniline sulphate and phloroglucin reactions clearly showed the lignin lamellæ colored, while the cavities or inter-lamellæ were unaltered. Aniline stains that act on lignified walls, such as safranin and aniline purple colored the lamellæ deeply and left the inter-lamellæ unstained. By appropriate protoplasmic stains, the inter-lamellæ were found to contain diffuse protoplasmic material in connection with the intercellular protoplasmic threads that penetrated the pores of the cell walls. The lamellæ were held in connection by fine lignin processes that stretched from lamella to lamella. The number of distinct lamellæ might vary from two to ten in the ordinary sap-conducting xylem tracheids and the fibrous sheath cells of the monocotyledonous bundle, to as many as from sixty to seventy in the indurated cells from the cortex of different plants.

That the lignified wall is built up of distinct lamellæ that alternate with interlamellar cavities containing protoplasm, gives a new conception as to the pathway for the ascending crude sap current and for the distribution of nutritive liquids through the tissues of the plants. It also furnishes valuable data for building up a correct conception of the minute structure of plant tissues, alike from the standpoint of intercellular protoplasmic continuity and of cell wall growth.

New Species of Genus Nepenthes: Professor John M. Macfarlane, of Lansdowne, Pa.

Five new species of pitcher plant were fully described or referred to in connection with his recent studies. These included *N. Beccariana* and *N. neglecta,* both obtained from the herbarium of Professor Beccari, of Florence; *N. Hemsleyana,* identified as a new species from specimens collected during the Burbidge and Veitch Expedition to North Borneo; *N. Copelandi,* determined and named by Dr. Merrill, head of the Botanical Survey of the Philippine Islands, and *N. Macfarlanei,* a species named by Mr. Hemsley, curator of the herbarium at Kew, from material discovered by the speaker in Kew Herbarium.

On Thought Transference Among Animals by Touch and Scent: Mr. Alden Sampson, of Haverford.

Mosaic Development in Ascidian Eggs: Professor Edwin G. Conklin, of Philadelphia.

The Oligodynamic Action of Copper Foil on Certain Intestinal Organisms: Henry Kraemer.

The classical experiments conducted by Nägeli during the eighties for determining the toxicity of solutions of copper produced by placing clean copper coins in distilled water for several days, on *Spirogyra*, a filamentous alga, was reviewed.

It was pointed out that Nägeli observed that the effects produced by the copper solution so obtained, on *Spirogyra*, differed from those due to ordinary chemical poisoning, and that in describing the supposedly distinctive effects of such minute traces of copper in solution (he having estimated that approximately 1.3 parts of copper to 1,000 million parts of water would kill *Spirogyra*), he used the term 'oligodynamische,' meaning thereby the force or action exerted by a small quantity of substance.

Reference was made to the very great importance of Nägeli's discovery from a scientific point of view, and the statement made that while researches of the kind conducted by Nägeli and other writers since his time had an important bearing on pharmacology, it was not, however, until the publication of the bulletin on 'A Method of Destroying or Preventing the Growth of Algæ and Certain Pathogenic Bacteria in Water Supplies,' by Moore and Kellerman nearly a year ago, that the very great practical significance of work along these lines became apparent and general interest was aroused in the subject.

Since last fall the author has carried on a number of series of experiments with the particular end in view of testing the efficiency of metallic copper for destroying typhoid and colon bacilli. The technique was described, and the following conclusions drawn from the results obtained as well as those given by other writers:

1. Certain intestinal bacteria, like colon and typhoid, are completely destroyed by placing clean copper foil in water containing them, or by adding the organisms to water previously in contact with the foil.

2. The toxicity of water to which either copper coins or copper foil has been added is probably due to the solution of some salt of copper, as first suggested by Nägeli.

3. The copper is probably in the form of a crystalloid rather than that of a colloid, as it has the property of permeating the cell walls and organized cell-contents of both animals and plants, thereby producing the toxic effects.

4. While the effects produced by the oligodynamic action of copper are apparently different from those of true chemical poisoning, the difference is probably in degree only and not in kind.

5. Certain lower organisms, including both plants and animals, possess a specific sensitiveness to minute quantities of copper and other substances as well, and it has been shown that they are not restored on transferring them to water free from oligodynamic properties.

6. Oligodynamic solutions of copper are obtained by adding copper coins, copper foil, or salts of copper to water. When copper foil is allowed to remain in distilled water from one to five minutes sufficient copper is dissolved by the water to kill typhoid organisms within two hours.

7. A solution of copper may lose its toxicity by the precipitation of the copper as an insoluble salt or compound, by its absorption by organic substances, or by adsorption by insoluble substances.

8. The oligodynamic action of the copper is dependent upon temperature as first pointed out by Israel and Klingmann.

9. The effects of oligodynamic copper in the purification of drinking water are in a quantitative sense much like those of filtration, only the organisms removed, like *B. typhi* and *B. coli*, are completely destroyed.

Observations on Columbium and Tantalum: Dr. Edgar F. Smith.

No difficulty was experienced in separating these elements. It was found that tantalum formed two or more double salts with the fluoride of each of the alkali metals. It was further shown that by virtue of this fact the double fluorides were not to be regarded as suitable material with which to determine the atomic weight of tantalum. Similar work was being done with columbium. The latter has not yet been freed absolutely from titanium, although certain methods being used at present promise well.

Tantalic and columbic oxides are both volatile in a current of carbon tetrachloride, the first yielding tantalum pentachloride and the second columbium oxychloride.

The Effects on Metabolism of Preservatives Added to Foods: H. W. Wiley, M.D., of Washington.

During the past three years we have studied in the Bureau of Chemistry in the Department of Agriculture, the various effects produced upon health and digestion by the addition of preservatives to food products. The substances which have been studied are boric acid, borax, salicylic acid, salicates, sulphurous acid, sulphite, benzoic acid, benzoates, formaldehyde and copper sulphate. The medical effects of all these bodies were carefully observed and recorded. The effects on metabolism were studied by weighing and analyzing the foods received, and collecting and analyzing the excreta of those under observation. The number of persons under observation has, in all cases, been twelve, except where accidental illness has diminished the attendance at the table. The effects produced upon the balance show the total quantity of any element ingested in the food and the amount recovered in the excreta. The research embraced protein, phosphoric acid, sulphuric acid, carbohydrates and fats. Only the data for boric acid and borax have been published. The other data are in course of preparation.

The general effect of borax and boric acid is: (1) To diminish or tend to diminish the weight of the body; (2) to diminish the avidity of the appetite; (3) a tendency to diminish the per cent. of nitrogen excreted, which, slightly marked in the preservative period, was even more marked in the after period, showing an accumulative effect in this direction; (4) the development of a tendency to increase the excretion of phosphorus. All the data taken together show that 97.3 per cent. of the phosphorus digested in the food was recovered during the fore period, 103.1 per cent. during the borax period, and 97 per cent. during the after period; (5) a tendency to increase, to a slight extent, the combustion of fat in the food; (6) a tendency to slightly diminish the total calories obtained from the food; and (7) a tendency to increase the quantity of solids in the food eliminated in the feces. This condition is easily explained in the tendency established during the exhibition of the preservative to slightly derange the digestive functions. The data also show that nearly 80 per cent. of the total borax and boric acid ingested in the food are excreted in the urine and the rest, apparently, through the skin.

The general result shows a greater or less derangement of metabolic processes of a character tending to injure the health.

Electroanalysis with a Rotating Anode and Mercury Cathode: Lily G. Kollock and Dr. Edgar F. Smith, of Philadelphia.

A number of metals may be rapidly precipitated in this way. The quantity of metal deposited in from four to seven minutes varies from a quarter to more than one half gram. The use of the mercury as cathode does away with a platinum dish or cone and greatly reduces the expense incurred in general electrolytic work. The metals studied were cadmium, zinc, iron, nickel, copper, cobalt and bismuth.

Afternoon Session—2:30 O'clock.

Vice-President Scott in the chair.

The Rounded Sands of Paleozoic Formations: Gilbert van Ingen, Princeton, N. J.

Certain sandstones and dolomites of Paleozoic age contain well-rounded grains of detrital quartz having the mat surface peculiar to sand which has been rounded during transportation by wind. Some of these sandstones are considered by the author to be of desert origin, others to represent fossil barrier bars and spits, still others dunes. The sand of the dolomites is believed to owe its presence in those marine rocks either to flotation from a barrier bar or spit or to transportation by wind from a desert or dune-covered shore. The evidence of these sand grains on paleogeographic conditions is briefly discussed.

A Review of Lacroix's Work on the Montagne Pelée (with lantern illustrations): Professor Angelo Heilprin.

The Mammalian Fauna of the Fort Union Beds: Mr. M. S. Farr.

The Marsupial Fauna of the Santa Cruz Beds: Wm. J. Sinclair, Princeton, N. J.

The paper presents some of the more important results of a study of the marsupials of the Santa Cruz formation of Patagonia, which will be treated monographically in the forthcoming Volume VII. of the reports of the 'Princeton University Expeditions to Patagonia.'

The large Santa Cruz carnivores are shown to be true marsupials, belonging to the same family as the Tasmanian wolf *Thylacinus*. The suborder Sparassodonta is proved to have been based on a mistaken assumption. Certain small forms comparable in size to the South American opossums are included in the family Didelphyidæ, but are not regarded as prototypal to any of the existing opossums. A new family is proposed for reception of the Santa Cruz diprotodonts, the most primitive members of which are shown to be transitional to the Polyprotodontia. The descent from common ancestors of certain Australian, Tasmanian and South American types is suggested, and its bearing on paleogeography briefly discussed.

The Mutual Affinities of the Species of the Genus Cambarus: A. E. Ortmann, of Pittsburg.

The Faunal Relations of the Ryu-kyu (Loo Choo) Islands: Dr. Henry A. Pilsbrey.

Evening Session—8 O'clock.

At the Free Museum of Science and Art, University of Pennsylvania, President Smith in the chair.

Reason and Intelligence vs. Custom and Habit in the Nutrition of the Body (illustrated by lantern slides): Professor Russell H. Chittenden.

A reception was given at nine o'clock in the museum by the president and council to the members of the society and the ladies accompanying them.

FRIDAY, APRIL 14.

Morning Session—10:30 O'clock.

Vice-President Newcomb in the chair.

The Secular Perturbations of the Earth: Mr. Eric Doolittle.

It is well known that the earth and all of the other planets move about the sun in almost circular curves called ellipses. But the size and shape of the path in which any one planet moves are constantly changing on account of the disturbing pull of all of the other planets. In order to prediet the position of any planet, or of the sun for use in surveying and navigation, at any future time, these minute changes in the form and position of the orbits must be rigorously calculated and allowed for. One method of doing this is by obtaining any variation in the form of an infinite series, and then adding together as many terms of this series as are thought to be necessary. The computations in the great work of Le Verrier and Newcomb were performed in this way.

The German mathematician, Gauss, has proved, however, that those variations of the orbit of any body which increase indefinitely with the time will be precisely the same as the variations produced, not by the pull of the other planets, but by the pull of a series of elliptic rings which respectively coincide with the orbits of these disturbing planets. The mathematical computation of the effect of the pull of these rings on the orbit of the disturbed planet leads to a definite integral instead of to an infinite series.

The present paper gives the results of this computation as applied to the orbit of the earth. It is part of a work on which the author is engaged, which, when completed, will give the computation for each of the four inner planets.

On the Problem of Four Bodies: Professor Edgar Odell Lovett, of Princeton.

Radio-Activity in Solar Phenomena: Professor Monroe B. Snyder, of Philadelphia.

Evidence Relating to Latitude Variations of Short Periods. From Observations at the Flower Observatory During the Year 1904: Professor C. L. Doolittle, of Philadelphia.

Enquiry into the Pressure and Rainfall Conditions of the Trades-Monsoon Area: W. L. Dallas, of the Meteorological Office, India. (Presented by Professor Abbe.)

Mr. W. L. Dallas, who has been prominent for twenty years past as the first assistant in the office of the 'Meteorological Reporter to the Government of India' communicated 'An Enquiry into the Pressure and Rainfall Conditions of the Trades-Monsoon Area.' This is a contribution to the great problem of predicting the character of the approaching crop season and the crop itself. In India the crop depends on the rains of the southwest monsoon. After they have ended the crop ripens and the harvest comes before the dry season is under way. Formerly we thought of the southwest monsoon as a northeast trade-wind from the north Indian Ocean diverted toward the warm interior of Asia and the slopes of the Himalayas. But the Indian meteorologists, by studying the reports of winds from the Indian Ocean have succeeded in demonstrating that the southwest monsoon comes across the equator and is with the southeast trade-wind of the southern Indian Ocean drawn towards India and Siam and China. The intensity and direction depend upon the distribution of barometric pressure from the Himalayas, south to Cape of Good Hope on the west and to Australia on the east. In fact, the great area of land that we divide up into three continents of Europe, Asia, Africa, act as one warm area, the great dry land hemisphere, to disturb the action of the great water hemisphere. The dry land and the aqueous hemispheres of our globe by their annual warming and cooling powerfully affect the general circulation of the atmosphere, transforming it into an attempt at a huge whirl around the continent in opposite directions in summer and winter.

In this transformation a large fraction of our whole atmosphere is involved; the general conditions of the air as to temperature, moisture, pressure and wind in distant regions affect this Asiatic whirl and it itself affects other distant regions. The monsoon rains of India depend on the intensity of the winds, the moisture of the air and the exact direction in which and date on which it moves over the country. It may, therefore, be said to depend mainly on the distribution of atmospheric pressure over an immense area, perhaps one third of the surface of the globe. But it may also depend ultimately on the intensity and quality of the radiation that we received from the sun, since that may exaggerate the difference of temperature over land and water or over equatorial and polar regions and thus cause slight deflections in the general currents of air. A relatively small disturbing cause may cause a deflection that will turn the southwest monsoon aside and cause it to pass by or over India or fall short of reaching it and thus cause a failure of the monsoon rains and of the crops that depend on them.

On the Construction of Isobaric Charts for Upper Levels and their Dynamic Importance in Dynamic Meteorology: Dr. J. W. Sandström, of Stockholm. (Presented by Professor Abbe.)

Dr. J. W. Sandström, of Stockholm, has long been a student of the atmosphere under the guidance of Professor Victor Bjerknes, of Stockholm, Sweden, and his eminent father the late Professor C. A. Bjerknes, of Christiania, Norway. These mathematicians have developed Kelvin's theorem of circulation within a fluid mass and have shown how to apply it to the earth's atmosphere, provided we have accurate values of the temperatures and pressures at various altitudes. To their work Dr. Sandström now adds an important practical consideration, *i. e.*, that the study of the motions of the upper atmosphere can best be made by drawing isobars and isotherms on successive level surfaces of equal gravity rather than on surfaces of equal height above mean sea level, as has hitherto been customary. In his memoir 'On the Construction of Isobaric Charts for Upper Levels and their Dynamic Importance in Dynamic Meteorology' Sandström gives formulæ and tables for this method of study and shows its advantages. It affords a peculiarly powerful method of utilizing the observations made at the seventeen kite stations occupied by the U. S. Weather Bureau in 1898, and his illustrative computations refer especially to these observations, as they were the first ever made that spread over so large area of country as to make it worth while to develop a method that is peculiarly suitable to them. At present this method also finds its most important application in studying the international aerial work now carried on by simultaneous ascensions to great heights once or twice monthly in Europe at fourteen balloon stations, seven kite stations, combined with twenty-five mountain-top stations and thirty-five or forty cloud or nephoscope stations. In this work the only American station at present contributing is the Blue Hill Observatory, but it is hoped that the U. S. Weather Bureau will eventually join in the great undertaking.

On the Straight-line Concept: Professor F. A. Lambert, of Bethlehem, Pa.

Precision is given to the straight-line concept not by experience or experiment, but by assumptions or axioms. These assumptions determine whether the straight line is that of the space of Euclid, of Lobatschefski or of Riemann. Cayley's theory of measurement causes much of the apparent mystery of these three spaces to vanish.

The geometry of Euclid does not require the straight line to be continuous.

At the annual election, which occurred at 12:30 o'clock, the following persons were chosen members:

RESIDENTS OF THE UNITED STATES.

Joseph S. Ames, Ph.D., Baltimore. Professor of physics in Johns Hopkins University; honorary member of the Royal Institution of Great Britain; member of the French Physical Society; author of 'Theory of Physics,' 'Manual of Experimental Physics,' 'Elements of Physics,' 'The Free Expansion of Gases,' 'Prismatic Diffractive Spectra,' 'Induction of Electric Currents'; assistant editor of *Astrophysical Journal* and associate editor of *American Journal of Science*.

Thomas Chrowder Chamberlin, Ph.D., LL.D., Chicago. Head professor of geology in University of Chicago; president of University of Wisconsin, 1887–92; in charge of glacial division of U. S. Geological Survey since 1882; geologist of Peary Relief Expedition, 1894; member of National Academy of Sciences; editor of *Journal of Geology;* author of 'Geology of Wisconsin,' 'Text-book of Geology,' etc., and of numerous papers relating to geology.

William Gilson Farlow, Cambridge. Professor of cryptogamic botany in Harvard University; author of 'Marine Algae of New England,' 'The Black Knot,' 'The Gymnosporangia of the United States,' 'The Potato Rot,' 'Index of Fungi,' 'Diseases of the Orange and Olive Trees,' etc., etc.; late president of the American Association for the Advancement of Science; member of the National Academy of Science and of the American Academy of Arts and Sciences.

Charles H. Frazier, M.D., Philadelphia. Dean of the medical department of the University of Pennsylvania and assistant professor of surgery; editor of the *University Medical Journal* and author of numerous monographs on surgical subjects.

David Starr Jordan, Stanford University, Cal. President of Leland Stanford University; author of 'Manual of Vertebrate Animals of Northern United States,' 'Fishes of North and Middle America,' 'Footnotes to Evolution,' 'Animal Forms,' 'Food and Game Fishes of North America,' 'A Guide to the Study of Fishes,' and numerous papers on ichthyology in proceedings of various societies and government bureaus; president of the California Academy of Sciences, 1896–98.

George Lyman Kittridge, LL.D., Cambridge. Professor of English in Harvard University; member of the American Philological Association and of the American Antiquarian Society and fellow of the American Academy of Arts and Sciences; has made valuable contributions to the study of Chaucer; author in collaboration with Professor Greenough of 'Words and Their Ways in English Speech,' and of numerous contributions to technical periodicals.

Robert G. Le Conte, M.D., Philadelphia. Surgeon to the Pennsylvania Hospital; adjunct professor of surgery and trustee of the University of Pennsylvania; late surgeon-general of the National Guard of Pennsylvania; author of a number of valuable contributions to surgical literature.

Eliakim Hastings Moore, Chicago. Head professor of mathematics at University of Chicago; president of the American Mathematical Society; associate fellow of the American Academy of Arts and Sciences; member of the National Academy of Sciences; editor of the *Transactions of the American Mathematical Society;* author of valuable contributions to mathematical science.

George T. Moore, Ph.D., Washington. Pathologist and algologist in charge of Laboratory of plant physiology, Bureau of Plant Industry, U. S. Department of Agriculture; author of papers on 'Soil Inoculation for Legumes,' 'A Method of Destroying or Preventing the Growth of Algae and Certain Pathogenic Bacteria in Water Supplies,' 'New or Little-known Unicellular Algae,' etc.

Richard A. F. Penrose, Jr., Ph.D., Philadelphia. Geologist and mining engineer; geologist in charge of survey of eastern Texas for Texas Geological Survey. Professor of economic geology, University of Chicago, 1892; special geologist, U. S. Geological Survey, 1894, to examine gold districts of Cripple Creek, Col.; fellow of Geological Society of America; member of Institute of Mining Engineers; National Geographical Society, etc.; author of numerous papers on economic geology.

Francis P. Venable, Ph.D., LL.D., Chapel Hill, N. C. President of the University of North Carolina; co-author of 'Inorganic Chemistry according to Periodic Law'; author of 'Development of Periodic Law' and of a 'Short History of Chemistry' and of numerous papers on inorganic chemistry; member of American Chemical Society, German Chemical Society; fellow of London Chemical Society.

J. Edward Whitfield, Philadelphia. Chemist, analytical and engineering; from 1880 to 1889 was connected with the U. S. Geological Survey as mineralogical chemist; author of analyses of ores and of Western Coals for Northern Transcontinental Survey, published in Tenth U. S. Census, and of numerous articles in the *American Chemical Journal*, *American Journal of Science* and *Journal of American Chemical Society*.

Bailey Willis, E.M., C.E., Washington. Geologist; in charge of the stratigraphic geology department of the U. S. Geological Survey, and is specially charged with the preparation of a geological map of the United States; in 1903–04 he journeyed through Siberia and China under the auspices of the Carnegie Institution to study the geological history of those countries in comparison with that of North America, and is about to extend his studies of mountain growth, etc., to some of the European ranges.

FOREIGN RESIDENTS.

Yves Delage, Paris. Professor of zoology and comparative anatomy at the Sorbonne; editor of *L'Année Biologique;* author of 'La Structure du Protoplasme et les Théories sur l'Hérédité,' Paris, 1895, and of numerous contributions to biology; member of the Institute of France.

Otto Nordenskjold, Stockholm. Eminent geographer and geologist; commanded Swedish Scientific Expedition to West Antarctica in 1901–1903; explored south and east coasts of Palmer Land, Danco Land and King Oscar Land, and has made numerous valuable contributions to knowledge in geography, geology, paleontology and meteorology. Author of 'Antarctic, tvä är bland Sydpolens isar,' published at Stockholm, and of many papers in the *Geographical Journal*, *La Geographie* and other scientific publications.

William Matthew Flinders Petrie, D.C.L., LL.D., F.R.S., London. Professor of Egyptology in University College, London; has made extensive excavations in Egypt and numerous important contributions to Egyptian archeology; author of 'Pyramids and Temples of Gizeh (1883), 'Tanis' (2 vols., 1888–89), 'Naukratis' (1886), 'History of Egypt' (1894–96), 'Abydos' (2 vols., 1901–02), etc.

Edward Sievers, Leipzig. Professor of the German language and literature in the University of Leipzig; an eminent authority in phonetics, text criticism and meters; author of 'Angelsachsische Grammatik,' 'Phonetik,' 'Altgermanische Metrik,' and of many other monographs.

Sir William Turner Thiselton-Dyer, LL.D., Ph.D., F.R.S., Kew, England. Eminent botanist; director of Royal Botanic Gardens; botanical adviser to the Secretary of State for the Colonies, and has contributed very largely to the development of the botanico-economic resources of the British Empire; editor of 'Flora Capensis' and of 'Flora of Tropical Africa.'

Afternoon Session—2:30 O'clock.

President Smith in the chair.

The Theory of the Double Suspension Pendulum: Professor R. S. Woodward.

The double suspension pendulum is an apparatus for determining the acceleration of gravity. It consists of a massive rectangular bar, which is held rigidly and horizontally, and from which is suspended a similar bar by means of two parallel steel tapes of equal length. These tapes pass through the bars and are clamped rigidly to them. The tapes may thus be regarded as elastic beams built in at both ends. The suspended bar vibrates longitudinally by reason of its weight and by reason of the elastic bending of the tapes. Measurements with the apparatus require observations of the time of vibration of the suspended bar and the lengths of the suspending tapes. This form of pendulum avoids entirely the difficulties of the knife edges of ordinary pendulums and has the additional advantage of superior steadiness arising from the large vibrating mass. The paper outlines the mathematical theory of the motions of such a pendulum.

The Relation Between the Economic Depth for Bridge Truss and the Depth which Gives Greatest Stiffness: Professor Mansfield Merriman, of Bethlehem, Pa.

The paper was read by the author. He explained that the increase in the depth of bridge trusses which has been going on for the past fifty years was due to considerations of economy and showed that there is a certain depth which gives the minimum amount of material. With respect to deflection under the passage of a train, it has generally been supposed that this continually decreased as the depth of the truss increased, but the author presented a proof that this is not the case. The deflection decreases with increase in depth up to a certain point and beyond that it increases. The computations of Professor Merriman indicate that the depth of truss which gives the least deflection or the greatest stiffness is a little less than the economic depth. He also showed that the relation between the economic depth and the span of the bridge applies very closely to the depth which gives the greatest stiffness.

On the Dispersion, Absorption, Fluorescence and Magnetic Rotation of Sodium Vapor: Professor Robert Williams Wood, of Baltimore.

A Photographic Study of the Diffusion of Ultra-Violet Light by Gas Particles: Professor Robert Williams Wood, of Baltimore.

On the Use of the Falling Plate Oscillograph as a Phasemeter: Dr. William McClellan, of Philadelphia.

The three general methods for obtaining the form of an alternating current wave are—by means of contact-maker and meter, by means of a curve-tracer and by means of an oscillograph. With the first and second methods the current must be kept absolutely constant, as some time is necessary to take the numerous readings required to plot the curve. The oscillograph gives a picture of a single wave. Essentially it is a sensitive moving-coil mirror galvanometer, with a period of about one ten-thousandth of a second. It is able, therefore, to follow easily currents of commercial frequency. To obtain the wave form it is necessary to have a uniform motion perpendicular to the motion of the coil. This is obtained by synchronous motors, revolving films or a falling photographic plate. The latter has been found to be very convenient, though its motion is uniformly accelerated instead of uniform. The error is small, however.

With a double oscillograph, that is one that can draw two curves simultaneously, for example the current and voltage waves of a single circuit, we can immediately see the possibility of a phasemeter. To test the accuracy of the instrument when used in this way, an Ayrton and Perry standard of self-induction, of known resistance, was used. Current and electromotive force waves were obtained and the angle of lag measured. These were compared with the values calculated from the constants of the standard.

On the Brains of Scymnus, Mitsukurina and Chlamydoselachus, with Remarks upon Selachian Brains from Standpoints Morphic, Ontogenic, Taxonomic, Phylogenic and Pedagogic: Professor Burt G. Wilder, of Ithaca.

Of the three sharks named in the title all occur in Japanese waters. *Mitsukurina* (which may be called the 'rostrum shark' from the extraordinary projection of the snout separated from the upper jaw by a deep notch) was first described in 1898 by Jordan and has not, as yet, been found elsewhere; it is so remarkable, and the examples already obtained are so few that the specimen exhibited cost about $75.00 So far as the speaker is aware its brain has never before been studied. *Chlamydoselachus* is also very rare, but besides the Japanese specimens at least one has been taken off Madeira. It was described in 1884 by Garman, who suggested 'frilled shark' as a popular name, referring to the folded covers of the gill-slits, of which there are six instead of five as with most modern sharks. The body is so long and snake-like that Garman gave it the specific name *anguincus*, and perhaps a good popular title might be the English form, anguin; it has even been thought by some that particularly large examples may have given color to the belief in the 'sea-serpent.' Garman's example was ill-preserved and the brain obviously in poor condition; the Cornell specimen is quite perfect. *Scymnus* has been long known; it is a rather ordinary-looking shark and occurs also in the Mediterranean, but it seems not to be very common, at any rate Professor Wilder has been unable to obtain a well-preserved specimen, and only recently has obtained a brain through the generosity of Professor Locy, of the Northwestern University.

Professor Wilder's special reason for studying the brain of *Scymnus* has been his wish to confirm or correct the account given in 1882 by the late T. Jeffery Parker, of New Zealand. According to this writer *Scymnus* 'exemplifies with diagrammatic clearness the typical structure of the vertebrate brain.' Professor Wilder finds that it really resembles more nearly the brain of *Heptanchus* and the earlier figures of Busch and Maclay; and this was to be expected since *Scymnus* is not, as to its other structures and its extinct relatives, such a very primitive type. But the simple conditions ascribed by Parker to *Scymnus* are more closely embodied in the anguin or frilled shark, whose cladodont relatives were in the Devonian epoch and which Garman regards 'the oldest [known] living type of vertebrate.' Here the walls of the forebrain are thinner and less differentiated, and in the lateral extensions toward the olfactory cups ('nostrils') the so-called cerebral portion expands nearly equally in every direction from the axis represented by the olfactory cruss; in most other sharks and in rays or skates the special cerebral extension is toward the meson or middle line, so as to meet the corresponding part of the other side; in the lamprey the cerebral extensions are away from the meson; in the Dipnoi, as shown by the speaker in 1887, they are downward, while in the ordinary and higher air-breathing vertebrates, reptiles, birds and mammals, the cerebral hemispheres expand mostly upward. It is as if nature had experimented in the four directions at right angles with one another from the primitive condition, nearly as in *Chlamydoselachus,* where the extension is almost uniformly in all directions from the olfactory axis. There were shown diagrams illustrating this idea, and also the possible derivation of the several grades of shark and ray brains from the hypothetic stem form, probably extinct and now inferred only from the embryonic conditions of recent forms. In this connection the speaker reiterated his previously expressed conviction that in evolution the olfactory portion of the brain had preceded the cerebral; that the ancestral vertebrates needed to smell rather than to think; that the organ of forethought had been, so to speak, an afterthought, and that the cerebral region, so preponderant in man, was rather an offshoot from the olfactory region, and had been interpolated between that and the hinder portions of the brain. The primitive preeminence of olfaction he regards as supported by the recent observations of Locy and others upon a nerve in most (probably all) sharks and rays and in some other generalized forms, connecting the nasal mucosa with the very front of the brain, and so slender as to have been commonly overlooked; in *Mitsukurina,* where the olfactory crura are extremely long, the nerve has been most skillfully worked out by Locy, to whom the Cornell brain was sent for the purpose. Although, from its late discovery, sometimes called the 'new nerve,' Professor Wilder thinks, perhaps, it is the very oldest; as suggested by Locy, its functions have been replaced by others, and it has become vistigial in the generalized vertebrates, having disappeared altogether in the higher. The speaker commended Locy's paper as a model research, displaying the 'five Cs,' clear, consistent, correct, concise and, so far as possible, complete.

Professor Wilder has long held that the very difficulties of neurology demand its early cultivation and that the elements of this most abstruse natural science, like those of astronomy, should be taught objectively in the primary schools. After trying various forms he concludes that the required pedagogic conditions are best met by the sharks and rays, particularly in respect to the ease with which they may now be had from the supply departments of the numerous marine laboratories; he believed it especially desirable that the beginner should himself lay bare the specimen so as to feel toward it an actual sense of ownership like that of a discoverer. Since the skulls of these fish are of cartilage, the brain can be exposed with the simplest instruments, even a jack-knife, better a small shoe-knife cut off obliquely.

In concluding Professor Wilder declared that the greatest mistake of his scientific life occurred while working on these sharks and rays in 1866–68 for the late Professor Louis Agassiz; he persisted in devoting himself to less noble and significant structures, notwithstanding the gently expressed preference of his too considerate employer. Since 1873 he has lost no opportunity of preparing and dissecting selachian brains, and hopes the present paper may arouse interest in them and lead to the recognition and elucidation of the numerous and complex problems connected with them.

The final event of this most successful meeting was a dinner at the Bellevue-Stratford on Friday evening. On this occasion Professor Edgar F. Smith, president of the society, acted as toastmaster. Addresses were made by President Smith; Dr. Woodrow Wilson, president of Princeton University, who responded to the toast 'The Memory of Franklin'; Dr. Woodward, president of the Carnegie Institution; Dr. H. W. Wiley, of Washington; Professor W. B. Scott, of Princeton, and Professor W. T. Hewett, of Cornell.

SCIENTIFIC BOOKS.

The Whalebone Whales of the Western North Atlantic, compared with those occurring in European Waters, with some observations on the species of the North Pacific. By Frederick W. True. City of Washington, published by the Smithsonian Institution. 1904. Pp. viii + 332; 97 text figures; 50 plates.

Those who are acquainted with the imperfect condition of our knowledge of whales, and particularly of the larger species, with the consequent multiplication of species and genera, will appreciate this memoir as well as realize the labor involved in its preparation. The objects of the work are to definitely decide the specific identity or difference of the species of whales occurring on the coast of Europe and America and to locate and identify the specimens on which the American species were based. These problems proved to be so involved that the subject of the distribution and migrations of the larger cetacea, which first led Mr. True to study the whales, had to be postponed.

That the synonymy of the larger cetacea should be involved is not surprising; owing to the practical impossibility of systematically collecting such animals, the greater part of the species are founded upon specimens, often fragmentary, that have accidentally come to hand, with the result that observations have been desultory and disconnected.

The first chapter of Dr. True's memoir is devoted to 'The Earliest References to Whalebone Whales in American Waters,' and this is full of information and interest to both naturalist and general reader, since it contains much information as to the extent and methods of the early whale fisheries on the eastern coast of North America. We learn that at a very early date (by the middle of the sixteenth century) there was a regularly established whale fishery on the coast of Newfoundland, while it is rather saddening to see how abundant were whales in those early days. Surely if the killing of whales has any direct or serious effect on any other fishery this effect must have been felt many years ago.

Chapter two is 'A Chronological Account of Important Contributions to the Natural History of North American Whalebone Whales' and in it, under date of 1741, we have the first systematic summary of the then known or recognized American species, in which some of them appear under the common English names by which they are yet known. It is a striking commentary on the lack of knowledge, or rather the large amount of misinformation, regarding whales, to note that this list is quite as understandable, and decidedly more accurate, than Gray's synopsis published in 1871.

This leads naturally to 'A Review of Cope's and Scammon's Species,' in which the species of the Atlantic coast are ruthlessly slaughtered, while later on doubt is cast on the specific identity of the larger Pacific whales which may prove to be identical with those of the Atlantic.

Chapters four to eight contain a systematic review, with many details as to measurements and coloration, of the finback, sulphurbottom, little piked whale, humpback and North Atlantic right whale, abundant comparisons being made with the work of other writers. Here we get what we actually know regarding the size, proportions and coloration of these great animals, and before passing to the conclusions deduced from them it may be worth while to note one or two points about the sulphurbottom, which is the largest of vertebrates. By the courtesy of Mr. Pike and Captain Bull, of the Cabot Company, it is possible to supply the measurements of the flukes, which Dr. True was unable to obtain, and to say that in males respectively 74 feet 8 inches and 74 feet 4 inches from fluke notch to tip of nose they were 16 feet 5 inches and 17 feet 2 inches in greatest spread. Various measurements of sulphurbottoms taken in 1903 agree with those taken by Dr. True, save that one female measured by him attained a length of 77 feet, or two feet more than any animal seen in 1903. As to the specimens noted abroad as having lengths of from 90 to 100 feet the reviewer frankly states his disbelief in their existence, though willing to grant that some giant may now and then reach a length over all, from tip of flukes to underhang of lower law, of 90 feet.

That the measurements of whales taken on the Norway coast should decidedly exceed those taken elsewhere is rather strange, and though it is barely possible that the largest animals occur there, the reviewer pleads guilty to a desire to measure one such animal himself, the more that it has never fallen to his lot to measure any animal that came up to the standard of size set by others. It is regrettable that the one measurement of a whale, from tip of nose to eye, that can be taken with certainty, is no safe criterion of the size of the animal, since the comparative length of the head is so extremely variable that there may be a difference of nearly a foot in this respect between two animals of equal length.

This naturally lessens the value of any ratios that may be made between the proportions of two whales. It is both interesting and discouraging to see how measurements of whales vary, but a part of the discrepancies shown may be explained by the difficulty commonly experienced in measuring cetaceans, while others are due to a failure to state how certain measurements were taken. This may possibly explain why Dr. True finds the flukes of the Newfoundland humpbacks wider than in European specimens, quoting 15 feet 8 inches and 17 feet 2 inches for whales respectively 42 and 45 feet long. A very accurate measure of the flukes of a humpback 50 feet long, following the curve of the back, gave a spread of only 13 feet 8 inches. It is also probable that the flukes show a great range of variation, as do the flippers.

Chapter ten gives the conclusions based on

Dr. True's studies, and these are that several American species which have been proposed are quite nominal and that, as a whole, the species of the Atlantic coast of North America can not be distinguished from those of European waters. Further, the whales of the Pacific coast, with the exception of the gray whale, bear an extremely close resemblance to those of the Atlantic, although at present material is not available to definitely determine whether or not they are specifically identical.

The eastern species admitted by Dr. True are the finback, *Balænoptera physalus* (Linn.); sulphurbottom, *B. musculus* (Linn.); little piked whale, *B. acuto-rostrata* Lacépède; pollack whale, *B. borealis* Lesson; humpback, *Megaptera nodosa* (Bonnaterre) and North Atlantic right whale, *Balæna glacialis* Bonnaterre. These scientific names are those recognized after a careful study of the literature and are practically those adopted in Dr. True's paper of 1898, since he noted that *M. nodosa* had been applied to the American humpback prior to the use of *M. longimana* for that taken on the European coast.

It is certainly a relief to see the species of cetacea rescued from the maze of synonymy in which they have for many years been involved, and if any one is so unfortunate as to come upon some unique work that would change any of the above names it is to be hoped that he will promptly destroy it and thus earn the gratitude of posterity.

The fifty plates, with from two to four figures on a plate, are devoted to reproductions from photographs of crania and other important parts of the skeletons, and many views of stranded whales and whales lying on the slips at whaling stations. The index is one that not even the *Nation* can criticize and Mr. True is to be congratulated upon the successful completion of a long and difficult piece of work.

F. A. L.

TWO RECENT MOSS BOOKS.

Dr. A. J. Grout has just published a second edition of 'Mosses with a Hand-Lens,'* which includes also some of the more common hepatics. The new edition, which follows the same general plan as the first edition, is expanded, to included 169 of the 'more common and more easily recognized mosses of the northeastern United States,' as well as fifty-four of the hepaticæ of the same region.

The descriptions are non-technical, and only such characters are employed as, according to the experience of the author, can be determined by the use of a powerful hand-lens. The key to the families of mosses is followed by a *brief* introduction and a *short* consideration of the life history and general structure of mosses. The last topic could be somewhat expanded with profit to the student. The text contains something like 118 figures and 39 full-page plates, the latter reproductions very largely from the Bryologia Europæa, which is a sufficient guarantee of their excellence. Many of the figures are rather lacking in clearness of detail, but in the matter of typography and illustrations, the work is so much of an improvement over its predecessor that it deserves special commendation.

To those who are without the advantages of a compound microscope and can not afford the author's more complete book, 'Mosses with Hand-Lens and Microscope,' this little volume will prove a valuable aid. If it serves as a stimulus to a more detailed study of this very interesting group of plants, its existence will be justified.

Many students of mosses will probably welcome the appearance of 'Moose' by Dr. W. Migula.* Although the work is primarily intended for German students, it contains much that will be valuable for American students, and its reasonable price places it within the reach of all.

The first chapter deals with the structure of the moss-plant, and the general features of

* 'Mosses with a Hand-Lens.' Second edition with Hepatics, pp. xvi + 208. March, 1905. $1.75. Published by the author, 306 Lenox Road, Flatbush, Borough of Brooklyn, New York City. Also O. T. Louis Co., 59 Fifth Ave., New York City.

* Band 1. 'Moose,' in Band V. of Professor Dr. Thome's 'Flora von Deutschland, Oesterreich, und der Schweiz.' Pp. vi + 512. 19 M. 1904. Friedrich von Zezschwitz. Gera, R.

taxonomic importance are clearly elucidated. Brief directions are then given for the collection of material and the determination of species, and this is followed by the taxonomic section which includes quite detailed descriptions of 916 species of mosses, with dichotomous keys to the families, genera and species. The system of classification adopted agrees very closely with that of Limpricht in Rabenhorst's 'Kryptogamen Flora von Deutschland.'

The second part of the work deals with the liverworts and in general arrangement follows that for the mosses. Keys and descriptions are given for 228 species. The work is bound in 'halbfranz,' and is embellished with 68 full-page lithographed plates, distributed throughout the text, of which 26 are executed in natural colors. The work is on the whole an admirable one, and it is only to be regretted that the production of such works is apparently not possible in our own country. It will form a valuable addition to the library of any student of mosses.

F. D. Heald.

The University of Nebraska.

SCIENTIFIC JOURNALS AND ARTICLES.

The contents of the March issue of *Terrestrial Magnetism and Atmospheric Electricity* is as follows:

Portrait of Svante August Arrhenius, Frontispiece.

S. A. Arrhenius: 'On the Electric Charge of the Sun.'

C. Chree: 'Review of Maunder's Recent Investigations on the Cause of Magnetic Disturbances.'

W. van Bemmelen: 'Magnetic Survey of the Dutch East Indies.' (Third communication.)

J. Elster und H. Geitel: 'Vorschläge für die Ausführung electrischer Beobachtungen während der bevorstehenden Sonnenfinsterniss.'

L. A. Bauer: 'Proposed Magnetic and Electric Observations during the Total Solar Eclipse of August 30, 1905' (Preliminary Information).

J. E. Burbank: 'Earth Currents: and a Proposed Method for their Investigation.'

Biographical Sketch of Svante August Arrhenius.

Letters to Editor: Nachtrag zur Abhandlung 'Ueber den Einfluss der Torsion bei den Ablenkungen eines hängenden Magneten,' F. Bidlingmaier; Tortosa Observatorio del Ebro (Illustrated), R. Cirera; Principal Magnetic Disturbances recorded at Cheltenham Magnetic Observatory, December 1, 1904, to March 1, 1905, W. F. Wallis; Present Russian Magnetic Observatories, M. Rykatscheff.

SOCIETIES AND ACADEMIES.

THE AMERICAN PHYSICAL SOCIETY.

The regular spring meeting of the Physical Society was held at the Ryerson Physical Laboratory of the University of Chicago on Friday, April 21, and Saturday, April 22, 1905. President Barus presided. The meeting was well attended, nearly all the colleges and universities within several hundred miles of Chicago being well represented. An informal dinner on Friday evening at the Quadrangle Club was a pleasant feature of the meeting. The program, which was the largest in the history of the society, is given below:

H. N. McCoy, University of Chicago: 'On the Relation between the Radioactivity and Composition of Uranium Compounds.'

G. G. Becknell, Northwestern University: 'The Residual e.m.f. of the Carbon Arc.'

C. W. Chamberlain, Denison University: 'The Radius of Molecular Attraction.'

G. M. Hobbs, University of Chicago: 'The Relation between p. d. and Spark Length for Small Values of the Latter.'

Carl Kinsley, University of Chicago: 'Short Spark Discharges.'

J. E. Almy, University of Nebraska: 'The Influence of Electrodes upon Spark Potentials.'

J. E. Almy, University of Nebraska: 'Note on the Potential Difference Required to Produce very Short Sparks.'

A. B. Porter, Chicago: 'Some Oddities in Lenses.'

A. H. Taylor, University of Wisconsin: 'On the Possible Variation of Inductance Standards with Temperature.'

E. M. Terry, University of Wisconsin: 'On the Variation of Capacity with Temperature.'

A. H. Taylor, University of Wisconsin: 'On the Comparison of Mutual Inductances.'

R. T. Herdegen, University of Wisconsin: 'The Comparison of the Mutual Inductance of a Pair of Coils with the Self-induction of One of Them.'

O. M. Stewart, University of Missouri: 'The Use of the Quadrant Electrometer in Measuring Current.'

R. R. Ramsey, University of Indiana: 'Polarization of Standard Cells.'

Henry Crew and B. T. Spence, Northwestern University: 'Variation of Arc Spectra with the Phase of the Current Producing Them.'

A. A. Michelson, University of Chicago: 'Reciprocal Relations in Diffraction.'

A. A. Michelson, University of Chicago: 'Report of Progress in Ruling Diffraction Gratings.'

A. A. Michelson, University of Chicago: 'On the Use of the Concave Mirror with Diffraction Gratings.'

N. A. Kent, Wabash College: 'The Relative Positions of the Arc and Spark Lines in the Spectra of Titanium and Zinc.'

H. M. Reese, University of Missouri: 'The Resolving Power of Quartz Prisms.'

E. S. Johonnott, Rose Polytechnic Institute: 'The Black Spot in Thin Liquid Films.'

F. L. Bishop, Bradley Polytechnic Institute: 'Thermal Conductivities.'

A. P. Carmen, University of Illinois: 'The Collapse of Tubes by External Pressure.'

A. B. Porter, Chicago: 'Abbe's Diffraction Theory of Microscopic Vision.'

F. R. Watson, University of Illinois: 'Surface Tension by the Method of Liquid Jets.'

A. L. Foley and J. H. Haseman, University of Indiana: 'Diffraction Fringes of Electric Discharges and the Fluid Streams.'

L. T. More, University of Cincinnati: 'On Dielectric Strain Along the Lines of Force.'

J. E. Almy, University of Nebraska: 'On the Dielectric Strength of Crystals.'

Percival Lewis, University of California: 'The Velocity of Ions in Gases from Colored Flames.' (By title.)

L. R. Ingersoll, University of Wisconsin: 'The Kerr Effect in the Infra-Red Spectrum.'

E. L. Nichols and Ernest Merritt, Cornell University: 'The Phosphorescence of Sidot Blend.'

W. W. Coblentz, Cornell University: 'Infra-Red Emission Spectra of Gases in Vacuum Tubes.' (By title.)

D. B. Brace, University of Nebraska: 'Æther Drift and the Rotary Polarization Test.'

D. B. Brace, University of Nebraska: 'On a Test of Anomalous Dispersion by Means of Channeled Spectra.'

C. B. Thwing, Syracuse University: 'Experiments on the Flow of Electricity in Metals under Changes of Pressure.'

H. A. Clark, University of Nebraska: 'The Absorption and Refraction of Carbon.'

Ernest Merritt,
Secretary.

AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION.

The sixth regular meeting of the New York Section was held Friday, March 10, at 8:30 p.m., in the American Museum of Natural History, 78th Street and Central Park West.

The program of the evening was as follows:

The Vapor Friction of Isomeric Ethers: Morris Loeb and F. S. M. Pederson.

The recorded experiments on the friction of vapors, by the transpiration method, having been made with cumbersome apparatus and at the temperature corresponding to the boiling points of the substances, it was thought important to devise a method whereby non-saturated vapors could be studied at identical temperatures, for the purpose of ascertaining whether the constitution as well as the composition of organic compounds influences the molecular volume, of which the vapor-friction is a function.

The apparatus used consists of a U-tube, one limb of which, about 60 cm. long, has a bore of less than one tenth of a millimeter, while the bend and the other limb is just wide enough to allow a column of mercury to descend unbroken. A stop-cock and funnel-end are placed on the wider tube, which also bears two marks about 50 cm. apart. The capacity of the tube between these marks is accurately determined. The whole apparatus can be heated uniformly, as it is surrounded by a vapor-jacket. Before heating, the liquid to be studied is poured into the tube and is vaporized as the temperature rises, in such a manner as to expel all air and foreign gases. A short column of mercury, of known length is introduced by means of the stop-cock, and in its descent forces the vapor through the capillary; the time in which the lower meniscus travels from the upper to the lower mark is ascertained by means of a stop-watch. The method is easy and rapid, and experiments with air gave results agreeing well among themselves and with the values obtained by the majority of previous observers. The calculations were made according to Poiseulle's formula, very few corrections being necessary.

From the study of isomeric ethers, as well as ethyl alcohol, it was found that the constitution has a decided influence upon the internal friction of the vapor, as will be seen from the following table, representing in each case the average of a number of experiments. The last column gives the comparative volumes of the molecules according to the formula suggested by L. Meyer, in which '*Y*' is the friction, '*M*' the molecular mass,

$$V = .00003 \left(\frac{M(1+aT)}{Y^2}\right)^{\frac{3}{4}}.$$

Substance.	Y.	V.
Methyl ether, $(CH_3)_2O$	1,133.5	55.53
Ethyl alcohol, C_2H_6O	1,100	58.09
Methyl-ethyl ether	1,030	78.2
Ethyl ether	944.7	110.4
Methyl-propyl ether	951.8	100.74
Methyl-isopropyl ether	992.3	96.46
Ethyl-propyl ether	874.9	133.2
Di-propyl ether	797.6	170.7
Di-isopropyl ether	841.5	157.8

The Iodine Absorption of Rosin and Shellac: A. C. LANGMUIR.

The paper states the results of further investigations in the iodine absorption of rosin and shellac. The various grades of rosin A. to W. W., ranged between 190.1 and 264.5 in the percentage of iodine absorbed. A number of pure shellacs of the years 1890 to 1895 were tested in order to find if there was any variation in different crops. The figures obtained were between 14.3 and 17.4 and are the same as those shown by similar grades to-day.

Decomposition of Ammonia at High Temperatures: WILLIAM MELVILLE and ALFRED H. WHITE.

The paper embodies the results of a series of experiments carried on in the chemical laboratory at the University of Michigan, by Mr. A. H. White, instructor in chemical technology, and Mr. Wm. Melville. The object of the experiments was to determine if possible the influence of surface contact upon the decomposition of ammonia, also the effect upon the decomposition, of mixing the ammonia with gases, which are generally present in the manufacture of illuminating gas, with a view to increasing the yield of ammonia in the manufacture of coal gas.

The results have been tabulated, and also plotted in the form of curves, showing the effect of increased temperature, rate of flow of gas, and dilution with hydrogen, nitrogen, carbon monoxide and water vapor.

Mineral Waters at the St. Louis Exposition: A. A. BRENEMAN.

The paper gave the experience and observations of the author as chairman of the International Jury on mineral waters at the St. Louis Exposition. He also drew some comparisons between the exhibition of 1904 and that at Chicago in 1893, where he filled a similar position.

Mineral waters at St. Louis were shown mainly in the departments of mines and metallurgy, a few only being in the agricultural building. The collection numbered about 160 samples. Notable among these was the collective exhibit of the U. S. Geological Survey embracing 125 samples of United States waters which are offered for sale, all neatly bottled and arranged on shelves and in a separate enclosure. Most of these were accompanied by analyses and descriptive circulars. Another feature of this exhibit was the illustration of the analysis of each water by a series of small jars containing powders which represented the proportion of the dry ingredients extracted from the waters, a demonstration which gave a much more tangible interpretation to the average visitor than the printed analyses.

The foreign exhibit was represented by Mexico, Brazil, Argentine and Peru, the last with an alkaline table water of exceptional merit. Mexico sent very good samples with alkaline and sulphureted waters. Germany, Hungary and Portugal monopolized the list from abroad with 8, 19 and 11 samples, respectively, while Belgium and Italy with one each completed the European list. These foreign waters deserve particular consideration because of their long transport and time of keeping, both tending to accentuate any defects. It would be difficult to find a fault in some of these samples as presented. Germany having the largest trade and greatest experience, rightly leads the list among these.

As compared with the exhibition of mineral waters at Chicago in 1893, the St. Louis display was smaller and had fewer countries represented, but was, on the whole, of better quality. Russia and Spain, which were largely represented in the earlier display, were both absent in 1904. American waters especially show a great improvement over the earlier period. The trade as a whole, in the United States, has grown from 21,569,608 gallons, worth $3,211,846 in 1894, to 51,242,719 gallons, worth $9,041,078 in 1903.

Radium Exhibits at the St. Louis Exposition: George F. Kunz.

The radium exhibit of the U. S. Geological Survey at the St. Louis Exposition was gathered under the auspices of the author for two main purposes: (1) As this was an exposition year, such a collection shown at a great fair would mean the interesting of a great number of people in radio-activity—one of the newer problems of the hour; (2) by the exhibition of a collection of apparatus and of the minerals themselves, it would lead many people to look for these minerals in various sections of the country. Both these objects were accomplished to a greater or less extent; and it is believed that the coming year will bring more facts in this direction than we possess at present.

The radium exhibit of the U. S. Geological Survey was also exhibited by the American Museum of Natural History on March 10 in a large series of cases, for the New York Section of the American Chemical Society.

The seventh regular meeting of the section was held at the Chemists' Club, Friday evening, April 7. The program of the evening was as follows:

Polarimetric Analysis: F. D. Dodge.

In a brief paper the author discusses some of the applications of the polariscope in chemical analysis, and shows that, for quantitative work, its use has so far been practically limited to sugar and similar substances.

The varying specific rotation of most optically active compounds under different conditions of solution and temperature, the interference of unknown substances, and difficulties with colored solutions, are among the principal causes which have prevented a more extended use of the instrument.

A method is also described by which some analyses, difficult or inconvenient by ordinary methods, can be carried out quickly and with reasonable accuracy by means of the polarimeter.

Quinazolines from 2-Amino 6-Nitrobenzoic Acid: Victor J. Chambers and M. T. Bogert.

The authors show that quinazolines may be readily obtained: (1) By heating 2-amino 6-nitrobenzoic acid in sealed tubes with nitriles and acid anhydrides, (2) by heating the ammonium salt of 2-acylamino 6-nitrobenzoic acid, (3) by fusing 2-amino 6-nitrobenzoic acid with amides, or (4) by treating 6-nitro acylanthranils with primary amines. 2-acetylamino 6-nitrobenzoic acid, 6-nitro acetylanthranil, the quinazoline, its 2-methyl, 2-phenyl and various other derivatives are described. Only three nitro-quinazolines are known besides those described in this paper.

Homo-anthranilic-nitril and some of its Derivatives, 7-Methylquinazolines: A. Hoffman and M. T. Bogert.

Starting with homo-anthranilic nitril a series of the aliphatic and aromatic acyl derivatives were made. In the case of the aliphatic derivatives, molecular proportions of the fatty acid anhydrides and nitril were heated together. The aromatic derivatives were made by dissolving the acid chlorides and the nitril in separate portions of pyridine and the solutions mixed. The compounds prepared were the acetyl, propionyl, isobutyryl, iso-valeryl, benzoyl, meta-nitrobenzoyl and para-nitro-benzoyl. The formyl derivative could not be obtained, as it immediately rearranges to the quinazoline.

By heating the acyl-homo-anthranitic nitril with alkaline hydrogen peroxide, 7-methyl-2-R-keto-dihydro-quinazolines were formed. This reaction works very smoothly and offers the advantage over the older methods that the homo-anthranitic nitril need not first be converted into the amide or the acid itself. The 7-methyl-keto-dihydro-quinazoline itself was made, and the following 2-R derivatives; methyl, ethyl, iso-propyl, iso-butyl, phenyl, meta-nitro-phenyl and para-nitro-phenyl.

Theories of Metabolism: Graham Lusk.

A mass of living matter composing an individual produces in metabolism exactly the same quantity of energy (which may be measured as heat) as any other similar individual mass of the same size and shape in the same environment. The cause of the metabolism is not due to oxygen and oxidizing enzymes for these are present in excess. The cause is not due to the satisfaction of chemical equivalents (as in Ehrlich's side-chain theory of immunity) for the metabolism proceeds in accordance with the utilization of energy equivalents (isodynamie values). The swinging motions of the cell partieles apparently act after the manner of catalysis, breaking up proteid, fat and the carbohydrates into simpler molecules, which may then unite with oxygen. The energy liberated through these chemical processes is in turn exactly sufficient to maintain those swinging motions of the cell particles whose aggregate we call life. After all is said, it is only possible to define metabolism as being due to unknown causes in the cells.

F. H. Pough,
Secretary.

THE CORNELL SECTION OF THE AMERICAN CHEMICAL SOCIETY.

At the March meeting of the Cornell Section of the American Chemical Society Mr. William W. Coblentz, Carnegie fellow, department of physics, Cornell University, read a paper on 'The Infra-red Emission and Absorption Spectra.' The speaker introduced his subject by showing several substances which emitted light, when heated slightly, while the iron plate containing the substance gave out no light. This shows the necessity of distinguishing between luminescence and a pure thermal radiation. After reviewing the ionic theory of emission and absorption spectra the speaker illustrated his researches on this subject by means of two series of lantern slides. The slides of emission spectra dealt with luminescent and pure thermal radiators, and comprised such radiators as the Nernst lamp, the acetylene and amylacetate flames, metals in the earbon arc, the spark discharge, the mercury arc and the vacuum tube radiation for different gases. The slides of absorption spectra dealt with compounds showing the following facts: isomerie compounds show that structure has a great influence upon the resulting absorption spectrum; that the maxima of absorption do not shift with increase in molecular weight; that the substitution of certain groups of atoms has a great influence upon the absorption spectrum; that the spectra of groups of compounds are similar and are characteristic of the grouping adopted by chemists; that carbohydrates have a characteristic spectrum; that several marked absorption bands are closely harmonie; that in compounds having water of crystallization certain absorption bands are coincident with those of ordinary water; that the CH_3 group has characteristic bands at 3.43 and 6.86, NH_3 at 2.96, OH at 3, NCS at 4.78, C_6H_6 at 3.25 and 6.75; and finally that in benzene derivations the original bands of benzene, C_6H_6, are found beside the new ones, e. g., those of CH_3, NH_2 or NCS, showing that the vibration of the benzene nucleus has not been destroyed.

At the meeting on April 18, 1905, Dr. A. W. Browne read a paper on 'A New Synthesis of Hydronitric Acid.'

Previous methods for the formation of hydronitric acid (or its inorganic salts) from hydrazine or its inorganic derivatives have involved, respectively, the action of nitrous acid, potassium nitrite, silver nitrite, nitric acid or nitrogen trichloride; or of oxidizing agents (such as chromic acid or hydrogen peroxide) in presence of hydroxylamine chloride. In no case has the compound been formed by the action upon hydrazine alone of a substance containing no nitrogen.

The method now to be described consists in the action of hydrogen peroxide upon hydrazine sulphate in presence of strong sulphuric acid. In eleven experiments performed under varying conditions yields of from 11.4 to 28.4 per cent. of hydronitric acid were obtained. The reaction may be considered to proceed in accordance with the following equation:

$$3N_2H_4 + 5H_2O_2 = 2HN_3 + 10H_2O.$$

The identity of the hydronitric acid was established by the following facts: (1) It possessed even in dilute solution the characteristic headache-producing odor; (2) when treated with ferric chloride solution it gave the usual blood-red color, destroyed by dilute hydrochloric acid and not destroyed by dilute mercuric chloride solution; (3) when treated with silver nitrate solution it gave a white precipitate completely soluble in dilute nitric acid. The dried precipitate exploded with violence when thrown upon a hot iron plate or when touched with a glowing platinum wire; (4) analyses of the silver salt showed it to be identical with silver trinitride.

Further experiments have shown that hydronitric acid may be obtained in small quantities by the action upon hydrazine sulphate of certain oxidizing agents other than hydrogen peroxide, some of which have been previously used by other investigators in the quantitative determination of hydrazine.

At a special meeting of the section held on May 2 at eight P.M., Dr. W. C. Geer, of the department of chemistry, Cornell University, read a very interesting paper entitled: 'The Chemistry of Indium.'

W. S. Lenk,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 167th meeting was held at the Cosmos Club, April 12.

The following papers were given as the regular program:

Terraces of the High Sierra, California: G. K. Gilbert.

The Sierra Nevada has long been recognized as a broad, sloping plateau having a steep face toward the east and a gentle descent from its crest to the western base. The fact has also been recognized that the general plateau is made up of subsidiary plateaus. In the northern part of the range it has been shown by Diller and others that various subsidiary plateaus are separated from one another by faults, and their discrepancies in altitude were caused by differential uplift. At the extreme south, in the basin of Kern River, Lawson has ascribed certain subsidiary plateaus to erosion, the surface of the range having been partially graded during pauses between epochs of uplift. The present studies pertain to the higher portions of the range, from the Kern River basin northward to that of the Tuolumne, a distance of more than 100 miles. Within this belt are (1) *summit plateaus* characterizing interstream areas and recording a long period, or periods, of degradation soon after the commencement of the Sierra uplift. Many of the peaks overlooking the summit plateaus, especially in the neighborhood of the crest line, have (2) *remnant surfaces* of moderate slope, strongly contrasted with the surrounding cliffs, produced for the most part by glacial erosion. And many of the valleys are bordered by (3) *high terraces,* in some cases expanded so as to constitute important plateaus. It is believed that the remnants of old topography at high altitudes were in the main once continuous with the summit plateaus, but the correlation is difficult, because the connecting slopes have been destroyed by the excessive development of glacial cirques. It is probable also that some of the valley plateaus at high levels will eventually be correlated with summit plateaus farther to the west, and it is also to be anticipated that the plateaus and terraces of the higher parts of the range will eventually be correlated with similar features near the western base of the range; but the latter have not yet been studied. In the upper Tuolumne basin a discordance of plateau levels appears to have been produced by comparatively recent dislocation, and somewhat similar phenomena were observed in the basin of Kings River.

The plateaus constitute part of the evidence by means of which the history of the uplift is to be read, and they also serve as datum planes from which the amount of subsequent erosion, especially glacial erosion, can be measured.

The Snowy Range of New South Wales: W. Lindgren.

As is well known, the Australian Cordillera follows the eastern coast of the continent until, in Victoria, it bends westward and finally dies out.

The highest points of this cordillera are situated in the southern part of New South Wales, not far from the Victorian boundary line, and somewhat exceed 7,000 feet in elevation; the culminating point is Mt. Kosciusko, which attains 7,300 feet. The Snowy Range, which includes most of this elevated district, constitutes the watershed between the interior drainage of the Murrumbidgee and Murray Rivers and that of the Snowy River which empties into the ocean in Victoria near the boundary line between that state and New South Wales.

The plateau sustains a very scanty vegetation of dwarfed eucalyptus. The climate is very cold, the temperature sinking to — 20° F. in the winter, and the snowfall is extremely heavy.

The rocks consist chiefly of the rather closely folded Paleozoic sediments which occupy so much space in the Cordillera. Their age ranges from Ordovician to early Carboniferous, and tuffs and intrusive granitic rocks of various kinds are associated with the sediments.

The so-called Snowy Range is not really a range at all, but a plateau of comparatively gentle relief, a peneplain in fact, with elevation ranging from 5,000 to 7,000 feet, in which the Tumut, Murrumbidgee and Eucumbene Rivers have cut abrupt canyons, the depth of which in some cases amounts to 3,000 feet. That this uplift is of comparatively recent age is proved by the basaltic flows which, near Kiandra, cover the summit of the plateau. The basalt covers an old auriferous river channel which has been traced for 20 miles by means of mining operations, and which has a gentle northward grade. Sand, clay and lignite cover the thin stratum of auriferous gravel to a depth of 150 feet and capping this the basalt flow attains a thickness of about 100 feet.

Geo. Otis Smith,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONCERNING THE NATURAL MOUNDS.

What has been said in Science recently (Nos. 530, 535 and 536, pp. 310, 514 and 551) by Mr. A. C. Veach and Professors Branner and Hilgard is of great interest to the writer, inasmuch as he has for some years been making observations on these mounds in Arkansas with the hope of reaching a satisfactory conclusion as to their origin. They have been observed along the western border of the Tertiary area, along the Arkansas valley, and in the northwestern part of the state. In outline, they are uniformly circular, and in size are rarely less than fifteen or more than thirty feet in diameter, and usually less than three feet in height.

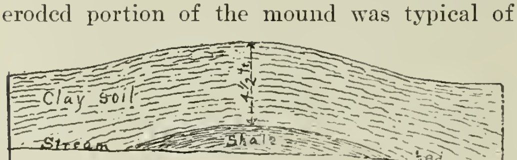
The theories of surface erosion, wind origin and human origin have been applied to these with the conclusion that none of them will hold. The uniformity of size and circular outline could not result from surface erosion. For the same reason, as Mr. Veach points out, they could not be the product of wind deposition. Besides, they always occur on clay soil, out of which and upon which, according to the writer's observations, the wind does not form dunes. The fact that they frequently occur in the most undesirable places for human abode, being on ground where both the surface drainage and underdrainage is poor, is in itself sufficient argument against the theory of human origin. The spring and gas vent theory is not tenable in the Paleozoic region, for the reason that Mr. Veach has stated.

After being forced to abandon the above theories, one of origin by burrowing animals, such as the gopher or prairie-dog, was held for some time, but the examination of a large number of sections disclosed by grading along railroads, wagon roads and cutting ditches through farms furnished no evidence of the material having been worked over, as must have been the case if such were the origin. However, this theory is not yet entirely abandoned.

As to the ant-hill theory, there are at present in the Arkansas valley large numbers of ant-hills from three to four feet in diameter, and often as much as fifteen inches high. These are found on the very soil where the mounds occur. But if the ancestors or forerunners of the living ants were the builders of the mounds, they must have existed in larger numbers and worked more industriously, for the present ant-hills are diminutive as compared with the mounds.

For some time the writer has entertained a theory very similar to that mentioned by Professor Branner. As above stated, these mounds are always on clay soil. In the Paleozoic region of Arkansas, they are on residual clay soils only a few feet deep, and of shale origin. As stated, the drainage where they occur is usually poor. These facts point to the action of ground-water within the clays or shales as being in some way responsible for the mounds. The action is thought to be one of the segregation of mineral matter, or as Professor Branner puts it, 'concretionary action on a large scale.' After the segregation, the volume may be further increased by hydration, oxidation and other chemical changes.

This idea was first suggested by a section of one of these mounds in the Arkansas valley that was brought to view by a small stream having cut its way through it and into the shale below, as shown in the figure. The uneroded portion of the mound was typical of



Section of a natural mound cut through by a stream.

the hundreds in the vicinity, and the general conformity of the surface to the arch of the shale would lead one to believe that the mound was due to the lifting of the shales beneath. While the writer has seen many sections through these mounds, this is the only one that discloses the shales, so that its value lies only in its suggestiveness.

In the Paleozoic region of Arkansas these mounds occur on at least three different beds of shale, two of which belong to the Lower Carboniferous, and the remaining one or more to the Coal Measures. These are all carbonaceous, clay shales. If their cause should prove to be a chemical one, induced by the action of ground-water, the question will present itself as to why they do not have a wide geographic distribution as well as a geologic one. The explanation would probably be found in the climatic conditions where the mounds occur. But this is scarcely worth speculating on till the origin of the mounds is determined.

A. H. Purdue.

The University of Arkansas,
Fayetteville, Ark.,
April 10, 1905.

THE BASALT MOUNDS OF THE COLUMBIA LAVA.

The recent discussion of various types of mounds of uncertain origin leads me to call attention to a form common in eastern Washington, which seems thus far to have escaped printed notice. Very conspicuous examples are found in the vicinities of Spangle and Medical Lake. Similar ones occur near Winona in the old bed of the Palouse River. Less striking examples are generally found along the crests of all the canyons hewn out by streams in the basalt, especially on the north walls. The general proportion of these mounds is about that of an upturned saucer, but occasionally more convex. The most conspicuous are about four feet high, about twice the height of the more usual ones. In diameter they vary from ten to twenty feet, or rarely more. The first generalization that forces itself upon one is that these mounds occur only where there has at one time been flowing water. They are conspicuous enough even at the top of Snake River canyon, though the river now flows on a bed two thousand feet below. Where these mounds occur along the crests of canyons there is usually but a single series of them. Where, on the other hand, they occupy the old beds of broad shallow streams, as at Medical Lake and near Spangle, there may be acres of them, rather evenly scattered, and often quite close together.

The soil of these mounds shows no appreciable difference from the surrounding soil of basaltic origin, and except in the rare cases where water stands about their bases, they do not support a vegetation more or less luxuriant than that of the surrounding soil. There is nothing, in short, in the structure of the ordinary mounds to give a clue to their origin.

A splendid series of these mounds along the lower Palouse River in the vicinity of Winona would seem, however, to point clearly to their mode of origin. No feature of the Columbia Basalt is more conspicuous than the isolated castle-like towers and crags that persist wherever there has been surface erosion. On the walls of canyons these are especially striking. One scarcely needs more than ocular evidence to know that these persisting crags have remained because formed of harder material. Actual experience in blasting ditches through the top of such a persisting crag demonstrated it to be many times harder than ordinary basalt, and of a somewhat different structure.

In the old bed of the river near Winona the series of mounds shows every gradation from rock caps to mounds of basalt boulders; and from these to ordinary basaltic soil. The conclusion seems unavoidable, therefore, that these mounds are the result of decaying basalt caps, from about which flowing water had previously worn the softer surrounding rock.

The cause of these harder basalt centers may be analogous to that of nodules. Be that as it may, they seem to be quite evenly distributed through the rock, as evidenced not only by their fairly regular occurrence on canyon walls, but especially by the distribution of the mounds in old shallow stream beds.

It was mentioned above that along canyons the mounds were discernible mainly on the north walls. This is due to the prevailing winds of the region being southwesterly, a fact that has led to the deposition of a considerable layer of fine soil on the south walls, and, therefore, the mounds are buried. The occurrence of the mounds only on the crests is doubtless owing to the much greater effect of erosion on the slopes.

C. V. Piper.

Department of Agriculture,
Washington, D. C.

SPECIAL ARTICLES.

LEVELING WITHOUT BASELEVELING.

Since the widespread adoption of Powell's views regarding baseleveling, whereby the earlier views regarding marine planation have been so generally displaced, truncated uplands—that is, uplands whose deformed structure is truncated by their surface—have come to be very generally interpreted as uplifted and more or less dissected peneplains. Doubt has been thrown, properly enough, on this interpretation in cases where the dissection of a supposed upland has progressed so far as to transform it into a series of discontinuous and uneven hills; but the interpretation has usually and deservedly had full acceptance in those cases where the dissection of the upland was but little advanced and where the inter-valley upland areas still preserved nearly plain surfaces, whose previous continuity across the valleys could not be reasonably questioned. It is evident, however, that the correctness of this interpretation depends on the impossibility of the production of similarly truncated uplands independent of normal baselevel; and those physiographers who have inferred crustal elevation on the evidence of truncated uplands have doubtless been convinced that this impossibility was demonstrated. True, it has long been understood that the processes of erosion and deposition in desert interior basins might result in leveling above baselevel, the waste from the highlands going to fill up the original depressions; but it does not appear that this process has been regarded as possibly accounting, after a change to a humid or normal climate and without any uplift, for the occurrence of truncated uplands in non-desert regions.

A recent article by Dr. Siegfried Passarge, of Steglitz, Germany, opens new possibilities in this direction. After extended observation on the desert plains of southern Africa, fully described in his book, 'Die Kalahari' (Berlin, 1904), Passarge concludes that these plains are the result of leveling without baseleveling, through the combined action of wind and water erosion; and that such plains, nearly everywhere showing a rock surface independent of structure and interrupted only here and there by residual hills or mountains—which he calls by Bornhardt's term 'Inselberge'—may be produced over large areas at any altitude above baselevel. His article, Rumpfflächen und Inselberg (*Zeitschr. deut. geol. Gesellsch.*, LVI., 1904, Protokol., 193–209), in which this conclusion is announced, is well worthy of attention from American physiographers.

The principle of leveling without baseleveling, or Passarge's law, as it may be called, in contrast to Powell's law of leveling by baseleveling, suggests that the scheme of the normal cycle of erosion, so generally applicable in regions of ordinary or normal climate, should be systematically modified in such ways as will adapt it to the conditions of an abnormally dry or arid climate. This modification I have lately attempted in an article that will soon be published in the *Journal of Geology;* it is here presented in outline.

An extensive region of any structure uplifted in an arid zone to any altitude and with any form will, in the youthful stage of its cycle of erosion, be characterized by as many independent and incomplete centripetal drainage systems as there are depressed areas or basins within its limits: independent systems, because in an arid climate the basins can not be filled with overflowing lakes; incomplete systems, because many of the intermittent centripetal streams will wither away on the slopes and fail to join forces in trunk streams on the basin floors. The early stage of a normal cycle, where all basins are filled to overflowing and where all streams are continued until they unite in trunk rivers which reach the sea, is characterized by a rapid increase of relief, due to the incision of valleys. The early stage of the arid cycle is, on the other hand, characterized by a decrease of relief, due to the aggradation of the basins with the waste washed down from the enclosing highlands. As youth advances towards maturity, the initially independent basins will become more and more completely confluent, either by headward erosion on the slopes of the lower basins, or by the overflow of waste across depressions in the borders of the higher basins; thus from original independence will be developed a maturely integrated and interdependent system of drainage slopes, although trunk rivers will still be wanting. Maturity may be said to be fully established when large areas are thus brought into systematic correlation. At this stage, there may still be some unreduced uplands, but there will also be increasing piedmont areas of degraded, rock-floored plains, inclined gently towards the greatly enlarged central aggraded basin floor; and the composite plain thus produced will have no definite relation to normal baselevel. In so far as the erosion of arid regions has previously been discussed, it would appear that this stage, here called maturity, has been regarded as the old age of a desert, and that it has been taken to mark the end of the changes to which an interior basin is subject, unless it is attacked by the headward extension of exterior streams and thus dissected and reduced to normal baselevel; but as Passarge clearly shows, the old age is yet to come, and with a systematic sequence and grouping of features essentially unlike those just described. The action of the wind is yet to be considered.

In the earlier stages of the cycle, while the slopes are still varied and strong, transportation and trituration by the wind is probably of small value in proportion to that of the occasional streams and floods. But as the barren surface becomes more and more even, the relative importance of wind action increases; for unlike running water, the wind does not depend on local slopes for its activity; it is about equally strong everywhere on a surface of moderate relief, and has no subdivision into subordinate parts that correspond to small headwater streams, whose slopes must be steeper than that of their trunk river. The wind may sweep sand along a level floor, or even up a moderate slope; and whirlwinds may raise dust high into the air, and there give it to the upper currents; both of these processes may carry desert waste outside of the desert region under consideration, and thus the mean level of the desert may be very slowly reduced. The surface may, indeed, in this way eventually be worn below sealevel, as several writers have suggested; but the form that the surface will exhibit during its slow reduction has not, to my knowledge, been especially considered until in the recent statement of this aspect of the question by Passarge.

It might at first sight appear that when the winds gain the upper hand in the processes of transportation, they would tend to excavate extensive basins wherever the weathering of the rocks resulted in the production of fine dusty waste; and that, inasmuch as the winds know no baselevel, there would be no definitely assignable limit to the unevenness of the surface thus produced. This might be true in absolutely rainless regions; but such regions are not known. The most desert regions of the world have occasional rainfall, and are from time to time visited by showers heavy enough to cause floods; and the intermittent action of such floods will put an effectual stop to the development of deep basins by wind action. As soon as the winds succeed in sweeping out a shallow depression, that part of the integrated drainage slopes which leads toward the depression will, when rain falls and floods are formed, provide a supply of waste with which the depression will be aggraded. Further deepening of the depression below its surroundings is thus effectually hindered. The wind may then begin the excavation of another depression elsewhere, only again to be defeated by the local inwash of a waste cover. Not an uneven surface of many hills and hollows, but a remarkably even plain must result from the long continuance of these antagonistic processes.

During the development of such a plain, a series of systematically irregular changes will run their course. As the exportation of desert waste by the winds continues, the area of the central aggraded basin floor must diminish, while that of the surrounding degraded rock plains must increase. At the same time, the integrated drainage system of maturity will be more and more completely disintegrated and replaced by many local and variable systems of extremely indefinite separation. Eventually all the central accumulation of waste will have been exported by the winds; the rock-floored plain will have been worn down lower than the bottom of the deepest initial depression, so that it will then extend throughout the region, except for residual mountains of rocks most resistant to dry weathering. Thin veneers of gravelly waste will remain, swept hither and yon by the intermittent fluctuating disintegrated drainage; shallow 'saltpans' may occur from place to place and from time to time; but large areas of rock plains carrying only scattered stony waste, will abound; this is the condition of true old age in such a region. Once attained, it persists, slowly worn lower and lower, possibly sinking below sealevel, until disturbed by crustal movements or climatic change. It is old rock-floored desert plains of this character and apparently of this origin that Passarge describes as occupying thousands of square miles in South Africa.

Two interesting consequences of this scheme should be pointed out.

Every truncated upland that has been described as an uplifted and more or less dissected peneplain should now be reexamined with the object of learning whether it may not have originated as a desert plain at its present altitude above sealevel, and afterwards suffered dissection as a result of climatic change. True, we are to-day more accustomed to movements of the earth crust, in the way of elevations and depressions, than to climatic changes, in the way of transforming arid regions to humid regions and *vice versa;* but perhaps this habit of thought is only a fashion of our time. A century ago, movements of the earth's crust indicated by the discovery of marine fossils on the higher peaks of the Alps were regarded with astonishment, not to say incredulity. A century hence, variations of climate may be accepted as freely as changes of level are now. The way towards such an opinion is opened by the discovery of glacial periods in various geological ages, and it is not hindered so much as it was once by supposed evidence of the correspondence of earlier climatic zones with those of to-day. We should, therefore, open our minds widely to the possibility of explaining truncated uplands as ancient desert plains not changed in elevation, but only in climate; and this possibility should not be set aside because it seems improbable, but only because it may be shown on good and sufficient grounds to be inappropriate to the case under consideration. It may be added that, as far as I have undertaken a revision of the origin of truncated uplands, as is suggested above, nearly all the familiar cases seem to possess characteristics that accord with their origin as uplifted peneplains and not as desert plains; and that there is therefore less ground for change of generally accepted opinions than the suggestion of the need of revision might for the moment indicate.

The second consideration concerns the processes of combined induction and deduction by which the complete or logical method of scientific investigation is constituted. In view of the possible change of interpretation now open for truncated uplands according to Passarge's law, it might be said by one who prefers to work on more purely inductive lines: "Behold, here is another case in which deduction has led the investigator astray! He thought that he could deduce the sole conditions under which truncated uplands could be formed, and that these conditions necessitated uplift after degradation; now he finds a new series of conditions under which such uplands may be formed and all his previous conclusions are uncertain. Let us, therefore, beware of deductive or imaginative methods, and hold fast to the safer methods of observation and induction." In reply to such a warning, one might say—besides pointing out that all problems which deal with unseen processes necessarily involve deduction and that the deductive side of the work should be conscious and systematic —that the fault in the method by which truncated uplands have heretofore been discussed lies not in the too free use of deductive methods, but in their too limited use. The mistake lies in our not having years ago set forth, by purely deductive methods, just such an analysis of the geographical cycle in an arid climate as has now been provoked by the discovery of rock-floored desert plains. Such an analysis does not involve any new or difficult problems; it might have been successfully attempted long ago; the difficulty that stood in the way lay not in the problem itself, but rather in the habit among physical geographers of trusting too largely to observational methods and of neglecting the aid that deductive methods furnish. The lesson of the problem is, therefore, that deduction should be pushed forward more energetically and systematically than ever; always checking its results as far as possible by confronting them with the appropriate facts of observation, but never halting in the reasonable extension of deductive conclusions because the corresponding facts of observation have not been detected; never lessening the activity with which exploration and observation are pursued, but always using the spur of deduction along the paths suggested by 'multiple working hypotheses.' The problem of the erosion of mountain valleys of Alpine glaciers teaches the same lesson: if physiographers had, thirty years ago, been well practised in deductive methods, they might have easily extended Playfair's law regarding the accordant junction of branch and trunk streams from the case of stream surfaces to the contrasted case of stream beds, and from the case of water streams to the analogous case of ice streams; thus they might have predicted that, if Alpine glaciers were effective eroding agents, glaciated mountain valleys ought to show discordant or hanging side valleys; and in going to the mountains they would have found the prediction correct, and the basis of the prediction—that glaciers are effective eroding agents—would have thus been verified. So with the geographical cycle in an arid climate: there is nothing difficult in the series of deductions that lead to the expectation of rock-floored desert plains, independent of baselevel, as the product of arid erosion; the only obstacle to the development of these deductions has been the habit of not making them. This is a habit that should be broken.

W. M. Davis.

NOMENCLATORIAL TYPE SPECIMENS OF PLANT SPECIES.

The recent 'Code of Botanical Nomenclature' now usually known as the Philadelphia Code, states as the fourth fundamental principle, 'The application of a name is determined by reference to its nomenclatorial type.' This means that a specific (or subspecific) name stands or falls according to the disposition of the type specimen. It is not proposed here to discuss the advantages or disadvantages of this method of determining the application of names, although to the writer this method seems much more likely to secure 'stability, uniformity and convenience in the designation of plants,' than the method of applying the name according to tradition, authority or consensus of opinion. Instead of this, then, it is proposed to discuss briefly the practical difficulties which may arise in this method of types, and how these difficulties may be overcome.

The code mentioned above states in regard to the application of names (Canon 14) the following: 'The nomenclatorial type of a species or subspecies is the specimen to which the describer originally applied the name in publication.'

Where an author in connection with an original description has indicated a definite specimen, there is usually no difficulty in determining the type. When an author indicates only the number or other data occurring on the label in numbered sets prepared for distribution, but does not specify a particular specimen, the type would be the one from which the author drew up the description and would presumably be in his herbarium. The other specimens would then be designated as duplicate types. Not infrequently the author draws the description from all the specimens of a given number in a set, in which case the specimen in the herbarium of the author, or of the institution at which he is located, must be arbitrarily chosen as the type.

Many difficulties arise in determining the types of the older authors, as the practise of designating specimens as such is quite recent. When a name is based upon a single specimen this becomes the type though not actually designated as such. If more than one specimen is cited, but none designated as the type it becomes necessary to select one of these.

The above mentioned code provides that 'When more than one specimen was originally cited, the type or group of specimens in which the type is included may be indicated by the derivation of the name from that of the collector, locality or host.' (Canon 14, a.) Further, if no type can be selected on this basis, 'Among specimens equally eligible, the type is that first figured with the original description, or in default of a figure, the first mentioned.' (Canon 14, b.)

There are many original descriptions, however, in which no specimens are cited, but instead the locality or range may be given. It then becomes necessary to consult the author's herbarium or the herbarium in which his plants are deposited. Specimens which bear the name in his handwriting should be given preference in the selection, and of these the type is the one from the locality first mentioned, or the one collected by the person for whom the species is named. Even with these aids in selection it may be necessary to arbitrarily select a certain specimen from among those equally eligible. This should be done by a monographer and only after a careful examination of the available data. Where possible the most perfect specimen should be selected or the one most nearly corresponding to the original description. For example, if the species is known to produce rhizomes and only one of the otherwise available specimens showed these organs, this specimen might be selected. Occasionally the original description includes more than one form and the specimens are correspondingly diverse. It is then very necessary to use particular care in the selection of the type. Muhlenberg described *Panicum depauperatum* without indicating a type. In his herbarium deposited in the Philadelphia Academy of Natural Sciences is the sheet of specimens upon which the name is founded. In this sheet are plants of *P. linearifolium* Scribn. and two forms of what is now considered to be *P. depauperatum* Muhl., one with glabrous sheaths and one with pilose sheaths. From the description one can not determine which one of these forms was intended. Probably all were included as one species. Since the form with smaller spikelets has been distinguished by Professor Scribner as *P. linearifolium* the type of *P. depauperatum* should be selected from the specimens with large spikelets. When the two or more species confused by one author are distinguished by a later author, this author should determine the type. The old specific name should remain with the type and the new name be based upon a different type. Much confusion has arisen because of failure to follow this rule. If the original specimens are made up of both species, the author of the later name, the so-called segregator, should indicate which specimen is the type of each species. Professor Scribner might with equal propriety have given the new name, in the case above mentioned, to the form with large spikelets, except for the fact that tradition, and the recorded history of the plant had attached the name *P. depauperatum* to this form. But, as stated, the original specimens are in part with glabrous sheaths and in part with pilose sheaths. The original description states that the sheaths are pilose. In a recent study of this collection in preparation of a monograph of the *Panicums* I took the liberty of selecting a specimen from the cover that had pilose sheaths, and attaching a ticket with such indication.

Let us consider another case and suppose that a reference to Muhlenberg's herbarium had shown only a specimen of *P. linearifolium* Scribn. In this case this specimen would become the type of the species *P. depauperatum* Muhl., since it agrees with Muhlenberg's description, and the species which had been called *P. depauperatum* would receive a new name.

While it is true that the name of a species rests upon its type specimen, yet the specimen can not take precedence over the description. If it is clear that a supposed type specimen disagrees with the description to such an extent that it can not be the plant which the author describes, then the plant must be disregarded in determining the type. In a previous paper I mentioned that the specimen in the Linnean Herbarium labeled in Linnæus's handwriting *Agrostis rubra* is a panicle of a *Sporobolus,* apparently *Sporobolus juncea* of our southern states. There is clearly an error here as the plant does not agree with the description. On the other hand, there are many cases in which the type specimen does not agree in all respects with the description. The sheaths may be described as glabrous when a few of the lower may be pubescent. If there is no reasonable doubt that the specimen was examined by the author and is the specimen or at least one of the specimens upon which the description was based, such specimen should be accepted as the type.

In cases where the first cited specimen is chosen as the type according to rule, it not infrequently happens that this is a form which does not represent faithfully the author's idea of the species. The specimens may have been arranged geographically and the first locality may be represented by a specimen of an aberrant or uncertain form. But the rule is explicit on this point and is certainly easy to interpret and follow.

Torrey and Gray publish many of Nuttall's manuscript names, but in listing specimens those collected by Nuttall may not be mentioned first; nevertheless, his specimens should be taken as the type by a broad interpretation of Canon 14, a. *Cardamine hirsuta* L. β *acuminata* Nutt. mss. in Torr. and Gray Fl. 1: 85. The specimens cited are: British America, Richardson; Oregon, Nuttall. The latter specimen should be taken as the type.

When there is no original specimen we must make use of Canon 14, c, in determining what shall serve as the type: 'In default of an original specimen, that represented by the identifiable figure or (in default of a figure) description first cited or subsequently published, shall serve as the type.' It sometimes happens that the citations will lead to a specimen, which then should be taken as the type. *Poa flava* L. is based upon a citation from Gronovius Flora Virginica, that is, Linnæus gives a specific name to a plant described by Gronovius. A reference to Gronovius shows that he mentions a particular specimen, Clayton No. 273, which plant is deposited in the herbarium of the British Museum and is the type of *Poa flava* L.

I will now refer briefly to a second series of cases, those where there has been only a change of name. If a species has been transferred from one genus to another the type specimen is determined according to the rules mentioned above, by a reference to the original description. If a new name is given to a species because the old one is untenable, the type of the old name becomes the type of the new. There are no new difficulties presented here, if there is no doubt that there has been only a change of name. However, one finds many cases where an author has changed a name and at the same time has given a description of the species as he understands it. The description may not agree with the historic type. If the author states the synonymy in such a manner that there is no doubt that he meant to change the name of a given species, the old type must be retained regardless of the description or the specimens cited at the time the change is made. This may sometimes become a question of judgment to decide whether there is primarily a change of name or a description of a species with a doubtful reference to a previously published species. For example:

(*a*) *Panicum barbipulvinatum* Nash. Mem. N. Y. Bot. Gard. 1: 21. 1900.

Panicum capillare brevifolium Vasey; Scribner, Bull. U. S. Dept. Agric. Div. Agrost. 5: 21; not *Panicum brevifolium* L.

Then follows an extended description and finally a specimen is cited as the type (Rydberg and Bessey 3544). This is evidently a change of name and the type should remain the same and be determined by a reference to the original publication of *P. capillare brevifolium* Vasey, where a certain specimen from Montana is mentioned, Rydberg & Shear 436. Even though it may have been that the plant described by Mr. Nash was a different species, still the name *P. barbipulvinatum* Nash is a typonym of *P. capillare brevifolium* Vasey and a new type can not be assigned.

(*b*) *Panicum scribnerianum* Nash. nom. n. Bul. Torr. Bot. Club. 22: 421. 1895.

Panicum scoparium S. Wats. in A. Gray, Man. Ed. 6, 632. 1890. Not Lam.

P. scoparium minor Scribn. Bul. Univ. Tenn. 7: 48. 1894. Not *P. capillare minor* Muhl. 1817.

The synonymy is arranged chronologically and both names are untenable. I believe that the fact that Mr. Nash chose *scribnerianum* for the new name is sufficient evidence to show that he intended to change the name of *P. scoparium minor* Scribn., and hence the type of the former is also the type of the latter, namely, a specimen from middle Tennessee collected by Gattinger.

Others may hold that the new name must rest upon the type of the plant described by Watson, since this is the first synonym cited. A reference to Watson's description shows that *P. pauciflorum* is given as a synonym in the 6th edition of the 'Manual'; that the description is identical with that under *P. pauciflorum* Ell.? of previous editions back to the first; that in the first edition the range is given as N. Pennsylvania (Carey) and W. New York to Michigan. In this case Carey's specimen becomes the type of the species doubtfully referred to *P. pauciflorum* Ell. by Gray and also the type of *P. scribnerianum* Nash.

(*c*) *Panicum minus* (Muhl.) Nash. Bul. Torr. Bot. Club. 22: 421. 1895.

P. diffusum Pursh 1814. Not Swartz 1788.

P. capillare minus Muhl. 1817.

P. philadelphicum Bernh. 1829.

Mr. Nash then describes his plant briefly, but sufficiently to show that it is not Muhlenberg's plant, but *P. capillare minimum* Engelm. Nevertheless, the type of *P. minus* (Muhl.) Nash must be that of *P. capillare minus* Muhl. (which, by the way, was not thus published by Muhlenberg), as there is primarily a change of name. It might be argued that *P. diffusum* Pursh is also a typonym of *P. minus* Nash. If Mr. Nash had given an entirely new name to *P. diffusum* Pursh, then the new name would have been a typonym of *P. diffusum*, but he chose to take up another name founded upon a different type, in which case *P. minus* Nash and *P. diffusum* are synonyms or at least supposed to be, but they are not typonyms.

(*d*) *Dactylis cynosuroides* L. Spec. 71. 1753.

Linnæus gives first a description of his own apparently based upon the specimen in his herbarium, which is *Spartina polystachya* Willd.; second, a citation from Gronovius Flora Virginica, which is supported by a specimen of *Spartina polystachya* Willd. in his herbarium; thirdly, a variety β which is *Spartina glabra* Muhl. The localities given are Virginia, Canada, Lusitania. All the evidence here is in one direction, and the type specimen is the one in the Linnæan herbarium. Michaux next transfers this to his genus *Trachynotia* as *T. cynosuroides*. As he uses the specific name *cynosuroides,* and quotes as synonym *Dactylis cynosuroides* L., we must consider this as primarily a change of name, although the plant he describes comes from Hudson Bay, and probably is *Spartina cynosuroides* as generally understood, that is, the plant from the interior, with few spikes.

Spartina cynosuroides Willd. Enum. 1: 80. 1809, must also be considered as a typonym of *Dactylis cynosuroides* L., since it is primarily a change of name. The description also applies. The two synonyms cited are *D. cynosuroides* Willd. Sp. 1: 40, which is based on Ait. Hort. Kew. 1: 103, which in its turn is based on *Dactylis cynosuroides* L. sp. 2d Ed. 104, and secondly upon *Trachynotia cynosuroides* Michx.

It is evident that Michaux took up Linnæus' name for the wrong plant, and his two species *T. cynosuroides* and *T. polystachya* must stand as synonyms. This leaves without a name the plant which Michaux describes under *T. cynosuroides*.

It is not best to be too arbitrary in deciding such cases and thus be led into an absurdity. This is particularly true for Linnæan species, as the conditions are unusual. Linnæus is introducing a new system and gives specific names to a large number of plants already well known. Judgment should be used so that a blind following of rules will not lead us into untenable positions. The American species are quite likely to be based upon type specimens which agree with his description. If there is no specimen in the Linnæan Herbarium the type should be traced, if possible, to a definite plate. If there are no plates and there is a conflict of cited descriptions, much care and study may be necessary in deciding upon what shall be a substitute for the type.

It is to be noted that there are many species of plants for which there are no nomenclatorial types. Only a few of Walter's grasses described in his 'Flora Caroliniana' are preserved in his herbarium now deposited in the British Museum. Names of species not represented in this collection are based upon descriptions and one can only say there is no type specimen. It may be that there is not in existence the type specimen of a species, according to the rules quoted, yet there may be other specimens which for practical purposes may take the place of the type. Many type specimens were lost at the time Professor Scribner's herbarium was destroyed by fire. Where there are duplicate types (specimens of a set or series bearing the same number or other data to show that they are a part of the same series) one of these may be chosen. It may be necessary to select a second or subsequently cited specimen to take the place of the type, when the latter is known to be lost. In all cases such a selection should be done by a monographer who has had opportunity to give the matter careful study.

A type specimen may consist of more than one individual plant. Consequently portions of the type specimen may be deposited in different places. In the National Herbarium are portions of the types of many species of grasses, such as those of Trinius, Muhlenberg and Elliott, sometimes consisting of an individual, more often of spikelets. These cases should not be confused with those mentioned above, where a description may have been drawn from all the specimens of a given number, one of which was retained in the author's herbarium and the remainder distributed. It would seem better, here, to distinguish the specimen or sheet of specimens in the author's herbarium as the type.

Finally, the following suggestions as to nomenclature are submitted:

Duplicate type: Specimens of the same series or set as the type as indicated by the number or other data.

Co-type: A specimen cited with the original description in addition to the type specimen.

A. S. Hitchcock.

U. S. Department of Agriculture.

CURRENT NOTES ON METEOROLOGY.

MOUNTAIN SICKNESS IN THE SIKHIM HIMALAYA.

Although much has been written about the physiological effects of high altitudes, every new contribution to the subject is of interest. In a recent account of 'The Sikhim Himalaya' (*Scot. Geogr. Mag.*, April, 1905), Mr. Douglas W. Freshfield gives the following summary of his party's experiences: Mountain sickness was felt more at about 15,000 to 16,000 feet than at 5,000 feet higher, and it was felt in very different degrees by different individuals. Most of the party suffered from lassitude and fatigue after making slight exertion; some were wholly prostrated for a time, and one coolie died. Other persons were entirely free from any perceptible inconvenience. Among the latter was a Goorkha, who *ran* back over a 20,000-foot pass to hurry up the loiterers. Another member of the party, an Englishman, experienced an increased appetite and gained in weight during the journey. Mr. Freshfield believes that the intense glare and heat on the snow had much to do with the sickness of some of the party at 15,000 feet.

THE KALAHARI DESERT.

A RECENT book on the Kalahari Desert ('Die Kalahari,' by Dr. Siegfried Passarge, Berlin, Reimer, 1904) contains a discussion of many interesting matters of a meteorological and climatological nature. Among these topics the following call for special mention: the climate of South Africa and of the Kalahari, with notes on the progressive desiccation of the country, based on comparisons of the observations of earlier and later explorers (Chap. V.); the orographic and hydrographic conditions of the Kalahari, with the evidence for the desiccation (Chap. XXXI.); the effects of rock-weathering under different climates, especially with reference to deserts (Chap. XXXV.), and the geological effects of wind action. Dr. Passarge's book, based on his own study of the Kalahari region during the years 1896–98, will be found to contain much of interest, especially to geologists, zoologists, botanists and meteorologists.

METEOROLOGICAL OBSERVATORY, NEW YEAR ISLAND.

IN the March number of the *Geographical Journal* Captain H. L. Crosthwait describes a recent journey in Patagonia, and also calls attention to the Argentine meteorological observatory, established in 1902, on New Year Island, in lat. 54°59′ S., about five miles off the north coast of Staten Island. Four Argentine naval officers man the station. Since the observations were begun the maximum temperature recorded is 55.4° F.; the minimum, 16.4°; the annual mean, 41°.

NOTES.

THE International Bureau of the South American Republics has recently issued a report upon 'Bolivia,' in which the climate of that country is discussed in a general way.

A HIGHLY mathematical discussion, by Max Margules, entitled 'Ueber die Energie der Stürme,' appears in the *Jahrbuch* of the Austrian Central Meteorological Institute, volume for 1903 (1905).

R. DEC. WARD.

NOTES ON ENTOMOLOGY.

THE varying positions in which insects rest have been but little investigated by entomologists. It is now known that in many groups the position of repose is constant, and of importance to the insect. In the Lepidoptera it often has a direct bearing on the color pattern, and on the question of protective resemblance. Dr. J. T. Oudemans has recently studied the subject and furnishes* many interesting observations on positions adopted, the arrangement of colors, the parts of the color-pattern exposed or hidden, and the cryptic value of the position and color. The photographs furnish many striking examples of protective resemblance, most of which are familiar to the American collector.

MR. PERGANDE'S revision of our phylloxeras, after much delay, has at last been issued.† The species affecting the hickory (being most numerous) are classed by themselves, and arranged in four groups according to the nature and position of the gall. Thirty species and several varieties are recorded from this genus of trees. Descriptions of the gall, stem-mother and larva are given for all species,

* 'Étude sur la position de repos chez des Lepidoptères,' *Verhdl. Konink. Akad. Wetensch. Amsterdam*, X., no. 1, pp. 90, 11 pls., 1903 (1904).

† 'North American Phylloxerinæ affecting *Hicoria* (*Carya*) and other trees,' *Proc. Davenport Acad. Sci.*, Vol. IX., pp. 185–273, 22 pls., 1904.

and various other stages in many of the forms. The complete life history is presented of one species—*P. perniciosa*. Seven other species are treated, on the willow, sour gum, poplar, oak and chestnut. *P. vastatrix*, the phylloxera of the vine, is purposely omitted. The excellent figures show the galls, as well as their inhabitants, but it is very much to be regretted that the colored figures of the galls prepared by the author could not have been published instead of the photographs.

The second entomological publication of the Carnegie Institution is equally as interesting as the first. It treats of the colors of a genus of common wasps—*Polistes*.* There are chapters on the origin, development and variation in the color pattern in these wasps; the geographical distribution of certain types of coloration in the United States, and a comparison with the distribution of these wasps in the world; on the chemical nature of the pigments; on variation in specimens from the same nest, and the degree of variability in males and females; and on the correlation in markings between different parts of the insect. These are followed by technical descriptions of the known species, and a bibliography of the subject.

For several years the Entomological Institute at Gifu, Japan, conducted by Mr. Nawa, has published a semipopular entomological paper. It now commences a series of more pretentious publications, the first number of which treats of the Sphingidæ of Japan, by K. Nagano.† It is in folio size and consists of 48 pages in Japanese and five colored plates, with an English translation of 15 pages in the back. Thirty-four species, with their larvæ, are figured on the plates. These are rather too highly colored.

A new entomological journal is *Časopis*, or *Acta Societatis Entomologicæ Bohemiæ*. It is published in Bohemian at Prague; four numbers are issued each year. It is edited by a committee of five Bohemian entomologists, headed by the eminent neuropterist, Professor Franz Klapálek. It treats mostly of local insects.

* W. M. Enteman, 'Coloration in Polistes,' Carnegie Institution, Washington, Publ. no. 19, 1904, pp. 88, 4 col. plates, 2 maps.

† 'Icones Japonicum Insectorum,' Vol. I., Lepidoptera Sphingidæ. Gifu, Japan, 1904.

The entomological literature of New Zealand has been enriched by two valuable books. One of them is a catalogue of all New Zealand animals.* The insects occupy a large part of the work. In the introduction there is a list of the various expeditions that have collected material on New Zealand; and an account of the different elements of the New Zealand fauna, and notes on the geological history of the island. The other book is a systematic account of the Neuroptera.† The neuropteroid fauna of New Zealand is characterized by many peculiar genera of caddice flies; and the author, in an appendix, shows that their larvæ are the principal food of trout.

M. Ch. Kerremans has begun a monographic account of the family Buprestidæ,‡ a group which he has studied for many years. Five parts have been issued, with 160 pages. The introduction contains much ethological matter on geographic distribution, variation, sexual dimorphism, mimicry and protective resemblance, etc.

Dr. Sjöstedt, who a few years ago published a considerable work on the termites of Africa, has now issued an appendix to that work.§ He here gives synoptic tables to all the species, new localities for many old species and descriptions of a considerable number of new forms. He wisely uses the genus *Termes* in the broad sense, ignoring the many new genera which have recently been created from it. There are many notes on the nests and habits of the species.

That the famous *Vedalia cardinalis* is not the only useful species of its genus is evi-

* 'Index Faunæ Novæ Zealandiæ,' by F. W. Hutton; London, Dulau and Co., 1904, 370 pp.

† 'New Zealand Neuroptera,' by G. V. Hudson; London, West, Newman and Co., 1904, 102 pp., 11 colored plates.

‡ 'Monographie des Buprestides,' Bruxelles, 8vo, 1904–1905.

§ 'Monographie der Termiten Afrikas, Nachtrag,' *Kgl. Svenska Vetensk.-Akad. Handl.*, Bd. 38, 1904, pp. 120, 4 pls.

denced by a paper on an injurious Indian scale-insect by Mr. Stebbing.* The scale-insect is a very large one (10–18 mm. long) that occurs in great numbers on sâl-trees in India. The *Vedalia, V. guerini,* is very voracious and feeds, both as larva and adult, on the scale. The latter, however, is so large that a beetle may suck its fill without killing the scale, which may feed or walk about while the *Vedalia* is sucking out its juices.

A MOST welcome addition to the small amount of good literature on the early stages of our beetles is the recent article by Messrs. G. Dimmock and F. Knab.† It contains a summary of the present knowledge of the larval structure in this family; directions for the rearing of the larvæ, notes on the habits of many species, detailed accounts of the early instars of four species, and a bibliography at the end. The four plates illustrate the larvæ and details of external anatomy.

DR. K. W. VERHOEFF has issued another one of his studies on insect morphology.‡ It is on the Embidæ, and deals especially with the structure of the thorax in this family. He finds further evidence in favor of the compound nature of the segments, and gives a table of the number of segments (33) which he traces in primitive insects. Systematically he would place the Embiidæ in the order Isoptera, dividing that order into two suborders, the Termitina and the Adenopoda, a new suborder for the Embidæ.

IN volume 12, no. 1, of the *Novitates Zoologicæ* Hon. N. C. Rothschild has given descriptions of sixteen new fleas of the genus *Ceratophyllus* from North America, mostly from western Canada. With them are four plates illustrative of the sexual characters of the species.

MR. W. F. KIRBY, of the British Museum, has added another volume to his series of world-catalogues of insects. This time it is the Orthoptera.* This volume treats of the Forficulidæ, Hemimeridæ, Blattidæ, Mantidæ and Phasmidæ. Each species is numbered, and the distribution is given on the margin of the page. Although the specialist will undoubtedly find errors and omissions, such catalogues are the most valuable additions that can be made to entomological literature.

NATHAN BANKS.

† 'On the Life History of a new Monophlebus from India, with a Note on that of a Vedalia Predaceous upon it,' *Journ. Linn. Soc. London, Zool.*, XXIX., pp. 142–161, 3 pls.

* 'Early Stages of Carabidæ,' Bull. no. 1, Springfield [Mass.] Museum of Natural History, Dec., 1904, pp. 55, 4 pls.

* 'Zur vergleichenden Morphologie und Systematik der Embiiden,' *K. Leop.-Carol. Deutschen Akad. Naturf.; Nova Acta*, LXXXII., pp. 145–205, 4 pls.

MEN OF AFFAIRS IN EDUCATION.

MR. FRANK A. VANDERLIP, ex-assistant secretary of the Treasury, and now vice-president of the National City Bank, addressed the students of Girard College on May 20, on the general subject of educational benefactions. He is reported to have said:

> The professional educator is quite as likely to become narrow and provincial as is any other specialist. The president of one of our great eastern universities told me a few days ago that he had been making an exhaustive examination of the history of his institution, and he had discovered that the great progressive steps which the university had taken in 150 years had been against the protest and the opposition of the faculty. The trustees from time to time brought forward new plans of organization, and broader ideas regarding the curriculum. The faculty had in every case voted adversely, and when the changes were made, they were made only by the trustees taking the responsibility upon themselves. Alexander Hamilton, with his consummate wisdom, once worked out a plan of reorganization for the university, only to have it meet with the usual vote of emphatic protest from the faculty, but final adoption by the trustees. Now, in the light of years of experience, these changes have been seen to be wise in the main. The unavailing protests of the learned men who made up the institution's faculty are discovered sometimes to have been based on narrow grounds lacking the impersonal view and judgment that should have been brought to bear upon the questions.

* 'A Synonymic Catalogue of Orthoptera,' Vol. I., Brit. Mus., London, 1904, pp. 501.

We should like to ask Mr. Vanderlip whether bank presidents and vice-presidents are not also likely to become 'narrow and provincial' and to lack 'impersonal view and judgment.' It appears that in accordance with Mr. Vanderlip's views university professors should administer the affairs of the National City Bank.

THE CARNEGIE FOUNDATION.

The foundation endowed by Mr. Andrew Carnegie with bonds of the market value $11,500,000, to establish a retiring pension fund for college professors, was incorporated at Albany, on May 10, with its principal office in New York City. The papers are signed by Nicholas Murray Butler, Alexander C. Humphreys, Henry S. Pritchett, Robert A. Franks and Frank A. Vanderlip for the board of directors.

The objects of the foundation are thus described:

> The particular objects for which said corporation is formed shall be:
>
> (*a*) To receive and maintain a fund and apply the income thereof as follows:
>
> To provide retiring pensions, without respect to race, sex, creed, or color, for the teachers of universities, colleges and technical schools in the United States, the Dominion of Canada and Newfoundland, who, by reason of long and meritorious service in these institutions shall be deemed by the board of directors to be entitled to the assistance and aid of this corporation or who by reason of old age or disability may be prevented from continuing in the active work of their profession;
>
> To provide for the care and maintenance of the widows and families of the said teachers;
>
> To make benefactions to charitable and educational institutions, and generally to promote the cause of science and education; provided, however, that the said benefactions shall be made to, and the said retiring pensions shall be paid to the teachers, their widows or families, of only such institutions as are not under control of a sect, do not require a majority of their trustees governing bodies, officers, faculties or students to belong to any specified sect, and do not impose any theological test.

THE INCREASED ENDOWMENT OF HARVARD COLLEGE.

It is announced that $1,800,000 has been contributed toward the endowment of $2,500,000 which is being collected 'to increase the present totally inadequate amount available for the salaries of the teaching staff of the college,' of Harvard University. The circular which contains this information and appeals for additional subscriptions is signed by Bishop William Lawrence, Francis L. Higginson, Charles S. Fairchild, Henry S. Howe, Francis R. Appleton, Augustus Hemenway, Robert Bacon, Theodore Roosevelt, James J. Storrow and Benjamin Carpenter.

The circular says: "The position of Harvard to-day among American universities is due not so much to its age, traditions, or able administration as to its noble line of teachers. That the teachers in the college should be the best in the land; that the older professors should be free from the cares of a straitened income; that the younger teachers should be able to give themselves without distraction to their work, and that the best men should not be drawn away to other colleges, but should see before them reasonable promotion in work and salary, is essential to the leadership of Harvard and the culture of her sons." It is pointed out that the total of salaries in Harvard College is $437,821, and the average per capita allowance for the staff of 279 teachers is only $1,570. "In these days of increasing cost of living and of higher salaries in commercial and industrial pursuits," the circular adds, "the alumni and friends of Harvard will not allow the men who teach their boys and who fill the chairs of the great teachers of the past to receive these meagre wages."

THE INTERNATIONAL ANATOMICAL CONGRESS AT GENEVA.

The first International Congress of Anatomists will be held at Geneva, Switzerland, on the 7th to 10th of August. The following national societies are to participate in this congress: The Anatomical Society of Great Britain, the Anatomische Gesellschaft, the Association des Anatomistes, the Association of American Anatomists and the Unione Zoologica Italiana. The organization of the congress has been entrusted to a committee representing these societies, and consisting of Professors Minot, Nicolas, Romiti, Symington and Waldeyer. The presidents thus far named are Professor Sabatier, of Montpellier; Professor Romiti, of Pisa, and Professor Minot, of Harvard. The vice-presidents are Professor Bugnion, of Lausanne; Professor Valenti, of Bologna, and Professor Carl Huber, of Ann Arbor.

A general circular is in preparation, which will shortly be distributed to all members of the various societies taking part in the congress, and to such other persons as may request to have it sent to them. The congress owes its successful initiation largely to the zealous devotion of Professor Nicolas, of the University of Nancy, and inquiries as to further details on the part of those interested may be addressed to him. We hope to publish later a more detailed notice of the final arrangements and program.

SCIENTIFIC NOTES AND NEWS.

THE faculty of Princeton University gave a dinner on the evening of May 17 in honor of Professor Charles A. Young, who becomes professor emeritus after a service of twenty-eight years as professor of astronomy. Among the speakers were President Woodrow Wilson, of Princeton; President Francis L. Patton, of Princeton Theological Seminary; Mr. M. Taylor Pyne, of New York; Professor Silas Brackett, Professor W. F. Magie and Dr. Henry Van Dyke, who read a poem. A loving cup was presented to Professor Young.

PROFESSOR J. J. THOMSON, F.R.S., of Cambridge University, has been elected professor of natural philosophy in the Royal Institution to succeed Lord Rayleigh, who becomes honorary professor.

PRESIDENT ROOSEVELT will receive the degree of LL.D. from Clark University on June 21, when he goes to attend the commencement exercises at the university.

THE pupils and friends of Professor Charles Eliot Norton have presented to Harvard University a fund of about $24,000, in his honor, to be used for the purchase of books for the library.

THE seventieth birthday of Professor Caesare Lombroso will be celebrated in connection with the sixth International Congress of Criminology, which meets at Turin next year.

DR. N. WILLE, professor of botany in Christiania, has been elected a foreign member of the Academy of Sciences at Stockholm.

DR. DAVID STARR JORDAN, of Stanford University, expects to spend the present summer abroad.

DR. N. L. BRITTON, director of the New York Botanical Garden, sails for Europe on May 27 to attend the International Botanical Congress, which meets at Vienna from June 11 to 18, and to visit foreign botanical gardens. He will be absent for about six weeks.

WE learn from the *Botanical Gazette* that Professor W. A. Kellerman, of Ohio State University, has returned from a three months' exploration of Guatemala with a large amount of material, especially of parasitic fungi.

DR. E. KOKEN, professor of geology at Tübingen, is about to return from a geological expedition to southern India and Ceylon.

DR. P. H. OLSSON-SEFFER, instructor in botany in Stanford University, will go to Soconusco, one of the southern provinces of Mexico, where he will spend three months experimenting with the Mexican rubber tree for the Zacualpa Rubber Plantation Company.

PROFESSOR A. JACOBI has been appointed to represent the faculty of medicine of Columbia University at the International Congress of Medicine to be held in Lisbon in April, 1906.

DR. WILLIAM OSLER sailed for Liverpool, on May 20, to assume the duties of the regius professorship of medicine at Oxford.

PROFESSOR IRA N. HOLLIS, professor of engineering at Harvard University, will be absent next year on leave.

ASSISTANT PROFESSOR D. S. SNEDDEN, of the department of education of Stanford University, has been given leave of absence for next year; Associate Professor E. P. Cubberley and Mr. A. H. Suzzallo, who have been spending the present year at Teachers College, Columbia University, will next year resume their work in the department of education.

Professors John C. Smock and Edward B. Voorhees, of Rutgers College, have been appointed to serve on the New Jersey State Forestry Commission.

Dr. J. Aderhold has been appointed director of the newly established Imperial Biological Institute for Agriculture and Forestry at Berlin.

The Paris Geographical Society has awarded its gold medal to Dr. Paul Doumer.

Henry Cook Boynton, instructor in mining and metallurgy at Harvard University, has been awarded the Carnegie research scholarship of $500 by the Iron and Steel Institute of London.

Professor Russell H. Chittenden, director of the Sheffield Scientific School, has been invited to deliver the annual Shattuck lecture before the Massachusetts Medical Society.

Foreign papers state that it is again proposed to affix a marble tablet to the Villa Medici, which is French property, to remind passers by and posterity that Galileo was kept prisoner there from June 24 to July 6, 1633. Italy has already erected a small monument to Galileo at the very door of the villa, with the following inscription: "The neighboring palace, which belonged to the Medici, was the prison of Galileo Galilei, guilty of having seen the earth revolving round the sun."

The deaths are announced of Dr. Henry Dufet, professor of physics at Paris, in his fifty-seventh year; of Dr. C. Eckhardt, professor of physiology at Giessen, in his eighty-third year; of Dr. Andreas Kornhuber, emeritus professor of natural history in the Institute of Technology at Vienna, in his eighty-fourth year; of Professor A. Piccini, professor of chemistry at Florence, and of Colonel Renard, director of the National Aeronautical Park at Meudon.

Plans for the International Congress of Radiology and Ionization to be held at Liége, September 12–14, 1905, are being rapidly matured. The 'Comité de Patronage' has been carefully selected and is an unusually dignified body, consisting of MM. Arrhenius, Barus, Becquerel, Berthelot, Birkeland, Blondlot, Bouchard, Crookes, Curie, D'Arsonval, Drude, Elster, Geitel, Goldstein, Hittorf, Kelvin, Larmor, Lenard, Lodge, Lorentz, Mascart, Nernst, Poincaré, Potier, Ramsay, Rayleigh, Riecke, Righi, Rutherford, Schuster, J. J. Thomson, Voigt and Wiedemann. It is hoped that an American committee may be arranged for at an early date, or at least that papers of a finished character may be sent from this country to the congress.

The Congrès des Sociétés savants met this year in Algeria under the presidency of M. Héron de Villefosse, president of the archeological section of historic and scientific work.

The following resolution was passed by the council of the Society of Arts at their meeting, held on May 8: "In view of the feeling which appears to have been aroused amongst some of the proprietors of the London Institution with regard to the proposed amalgamation with the Society of Arts, and the consequent probable difficulties of effecting a harmonious fusion of the two corporations into a single institution, the council of the Society of Arts have decided not to take any further action in the matter, and hereby discharge the committee which, at the instance of the board of managers of the London Institution, they appointed to consider the scheme for amalgamation."

The U. S. Civil Service Commission announces an examination on June 21, 1905, to secure eligibles from which to make certification to fill the following named vacancies in the positions of aid and laboratory apprentice (male) in the Bureau of Standards, Department of Commerce and Labor, and vacancies as they may occur in any branch of the service requiring similar qualifications: Three aids, at $600 per annum each; one laboratory apprentice, at $480 per annum; one laboratory apprentice, at $540 per annum.

It is announced that President Roosevelt will soon issue a proclamation setting aside about ten million acres of land in Idaho as a forest reserve.

The following subject has been selected as the subject for the Jacksonian prize of the Royal College of Surgeons for 1906: 'The

Diagnosis and Treatment of Those Diseases and Morbid Growths of Vertebral Column and Spinal Cord and Canal which are Amenable to Surgical Operations.'

Although detailed statistics for the production of gold during the last year are not yet available, Mr. Waldemar Lindgren, of the U. S. Geological Survey, has made some prognostications as to the distribution of the production among different classes of ore deposits. A preliminary estimate of the production of each state and territory was given out by the director of the Mint at the first of the year. According to this estimate, the production of gold in the United States during 1904 amounted to $84,551,300. After a period of very rapid advance in the gold production from 1892 to 1900, inclusive, during which an increase from $33,000,000 to $79,000,000 took place, there were two years of nearly stationary output and one year of decided decrease. It is, therefore, very satisfactory to find that the production of gold has risen again to record figures, the estimate being $84,551,300 against $73,591,700 for 1903. Mr. Lindgren classifies the gold production according to its derivation from placers, dry or quartzose ores, copper ores and lead ores. He estimates the production of gold from placers at $12,900,000, from quartzose gold and silver ores at $62,754,000, from copper ores at $4,300,000 and from lead ores at $4,600,000, making a total production of $84,554,000, a sum that practically agrees with the estimate of the director of the mint. Alaska is the largest producer of placer gold and should show a gain of at least $200,000, the output being estimated at $5,800,000. California will show an increase which may reach $800,000, the production being estimated at $4,800,000. The production of gold from quartzose gold and silver ores is subdivided by Mr. Lindgren into the production of pre-Cambrian quartz veins, $5,454,000; of Mesozoic quartz veins in the Pacific coast belt, $21,600,000; and of Tertiary gold quartz veins in the Rocky Mountains and Great Basin, $35,700, making a total of $62,754,000.

The Belgian Royal Academy has, as reported in *Nature,* issued the following lists of prize subjects for 1905 and 1906: for 1905, in mathematical and physical sciences, on the combinations formed by halogens; on physical, particularly thermal, phenomena accompanying dissolution; on linear complexes of the third order; and on the deviation of the vertical treated from the hypothesis of the non-coincidence of the centers of mass of the earth's crust and nucleus. In natural sciences, on the function of albuminoids in nutrition; on the reproduction and sexuality of Dicyemidæ; on the silicates of Belgium; on the formations of Brabrant between the Bruxellian and the Tongrian; on certain Belgian deposits of sand, clay and pebbles; on the sexuality of the individuals resulting from a single ovum in certain diœcious plants; and on the development of *Amphioxus.* For 1906 the subjects in mathematical and physical sciences are: on critical phenomena in physics; on n-linear forms ($n>3$); on thermal conductivity of liquids and solutions; and on the unipolar induction of Weber. In natural sciences, on the Cambrian series of Stavelot; on the effect of mineral substances on the assimilation of carbon by organisms; on the effects of osmotic pressure in animal life; on the tectonic of Brabrant; on the soluble ferments of milk; and on the physiological action of histones. The essays for 1905 and 1906 are to be sent in by August 1 of the respective years, and the prizes range from $120 to $200 in value. In addition, prizes bequeathed by Edward Mailly and in memory of Louis Melsens are offered under the usual conditions for astronomy and applied chemistry or physics respectively.

UNIVERSITY AND EDUCATIONAL NEWS.

The cornerstone of the library building of Leland Stanford Junior University was laid on May 15. The building will cost $800,000. At the ceremonies an address to the students by Mrs. Stanford was read. In it she makes the amount realized from the sale of her jewels, which are estimated to be worth $500,000, an endowment fund for the library.

Graduates of Yale University have arranged to purchase for the university the Hillhouse estate, containing thirty acres and costing $510,000. This purchase fixes definitely the direction of Yale's growth northward beyond the present site of the Sheffield Scientific School.

It was announced at the meeting of the Yale Corporation, on May 15, that a gift had been received by Yale from a Harvard graduate—whose name was withheld—for the purpose of cementing the good feeling between the two universities. The use of the fund was left entirely to the Yale Corporation, which has voted to expend it for securing from time to time lecturers from Harvard to speak before the students of Yale. President Eliot, of Harvard, has accepted the corporation's invitation to be the first lecturer.

The University of Indiana has been granted $100,000 by the state legislature for the erection of a new library.

Work is about to be started on the new science hall of Colby University, which will be erected at a cost of about $90,000.

Dr. D. K. Pearsons, of Chicago has made a gift of $50,000 to Montpelier Seminary at Montpelier, Vt., which he attended, conditional upon the institution raising $100,000 within a year.

At the annual meeting of the National Academy of Design it was voted to accept the offer of Columbia University to form an affiliation. It is planned to collect $500,000 for a building, which will be erected on a site furnished by Columbia University.

The University of North Dakota will open a medical college in the autumn of 1905. Until the clinical advantages are adequate the medical course will extend only through the first and second years of the four years' curriculum. Students who have completed the work at the University of North Dakota will be received into the junior year of the medical schools with which articulation is arranged.

The Medical College at Bahia, Brazil, with its equipment and valuable library, has almost totally been destroyed by fire.

Dublin University has recently opened its degrees to women, and the first result has been somewhat curious. Students who have done their work at Oxford or Cambridge may receive the bachelor's degree at Dublin. As is well known, Oxford and Cambridge do not give their bachelor's degree to women, and eighty-four women who had completed the work for the degree at these universities have received the degree from Dublin on the payment of $50 each.

Professor Asaph Hall, Jr., has resigned as professor of astronomy and director of the observatory at the University of Michigan. Professor W. T. Hussey, of the Lick Observatory, has been elected his successor. Professor Hussey was graduated from Michigan in 1889.

Samuel J. Barnett, assistant professor of physics at Stanford University, has accepted the chair of physics at Tulane University, vacant by the resignation of Dr. Brown Ayres to accept the presidency of the University of Tennessee.

The department of physics in the University of California has secured the appointment of Dr. A. S. King and Dr. A. W. Gray for the coming year, as instructors. Dr. King will continue the spectroscopic investigations on which he has published already a number of papers. Dr. Gray returns from the University of Leyden, where he has been working in the cryogenic laboratory, to a 'Research Instructorship on the Whiting Foundation,' supported from the income of the bequest of Harold Whiting, formerly associate professor of physics in the University of California.

At Williams College, Mr. William E. McElfresh has been promoted to the Thomas T. Reed professorship of physics, and Mr. Herdman L. Clelland to a professorship in geology.

Dr. E. B. Holt has been appointed assistant professor of psychology at Harvard University.

Dr. A. R. Ferguson, senior assistant to the professor of pathology in Glasgow University, has been appointed professor of pathology in the Medical School, Cairo.

The council of the Linnean Society of New South Wales has appointed Mr. Harald I. Jensen to be the first Linnean Maclay fellow.

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FRIDAY, JUNE 2, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE PHYSICIAN OF THE FUTURE.**

THE day which marks the beginning of a career is always one of interest. Especially is this so for him whose career begins, if indeed a career can be said to have definite commencement. But little less of interest, however, is felt also by his friends, and the day partakes of the nature of an inauguration or a marriage. It is a general day of rejoicing. The graduate himself is happy in the thought that his labors, at least for the time being, are over; his friends are glad to see the honor which he has earned, and the general public takes almost the same interest in the graduate that it does in the lover.

This particular occasion, when those who have completed the prescribed course of medical and dental science present themselves to receive their degrees, is of especial interest. This probably marks the last commencement of the medical and dental school of old Columbian. More than three quarters of a century of achievement marks her successful career. Thousands of graduates scattered throughout the land are proud of the alma mater who started them in life. The change of name, therefore, to George Washington University is not looked upon with unmixed joy, especially by the older children. A mother is, perhaps, no less a mother because, when widowed, she marries another man and takes another name. The academic mother

* Address delivered before the graduating class of the medical and dental schools of Columbian (George Washington) University, Monday, May 30, 1904.

of this widely scattered and numerous family need be no less loved, no less cherished and no less helpful than under her old name.

There are some of the arts which are nearer to the welfare of man than others, and the same is true of the sciences. There are two arts, however, which lie very near human welfare and if we were called upon to give up all of the arts but two, I think there would be little difference in choice as to which two should be preserved. The one most important would be the art of agriculture and the next the art of healing. Man first of all must be nourished and next to this, kept in health.

We might look forward to a time when lawyers would disappear. We might even grow so perfect as to be able to do without ministers of the gospel. Even the histrionic art might be abandoned, and yet mankind be reasonably happy. But strike down agriculture and you strike a blow which is fatal; banish the healing art and you leave man to the ravages of disease. It is, therefore, probably not without some fitness that you have asked a 'farmer' to deliver this address, and it is quite becoming that on this occasion Ceres and Hygeia should be seen hand in hand.

The man who receives his degree believes he knows something and the public supposes that his belief is well founded. The amount known, however, or supposed to be known, varies greatly for different degrees. The college graduate, it has been said, doubtless supposes that he knows all things from *A* to *Z*, but the faculty and trustees, with a better idea of his accomplishments, give him only the degree *A.B.* If I remember aright my Roman numerals an *M.D.* should know at least 1,500 times more than an *A.B.* Yet without doubt the degree *M.D.* or *D.D.S.* should carry a greater ballast of knowledge than the first degrees of the academy. We may, with reason, doubt the propriety of conferring the degree of 'doctor' even upon those who have accomplished as much as you young men who are now before me. *Doctor* signifies 'knowing,' 'learned.' The physician should not—and perhaps no one should—bear this degree who has not added something to the sum of human knowledge. Some of the most famous surgeons and physicians of England are only plain 'mister' and I fail to see where there would be any diminution in your skill if the degree which you receive to-night were 'bachelor' instead of 'doctor.' I am not quarreling, however, with the usual custom, but mention this matter only to show you that bearing this degree you assume a responsibility of which you must strive to be worthy. The doctor is the teacher, the learned man, the *knower* as well as the *doer*. He is the man to whom people must come for knowledge, advice and inspiration. He is, moreover, the *dux*, the *imperator* in the empire of knowledge. Like the thirsting Omar Khayyam, each one should be able to say, 'Myself when young did eagerly frequent doctor and saint and heard great argument,' but the doctors and saints should be of better quality than in those medieval days, for in the present day we should not be compelled to add, 'About it and about but evermore, came out by the same door as in I went.'

Health comes largely from good food and good hygiene, but one of the necessities to health is good mastication. Teeth are useful for other purposes than merely to improve looks, but even if they were only for this purpose they would be worth saving. Many a man has married a beautiful set of teeth and, perhaps, afterwards discovered, to his amazement, that they were the fruit of dental science, but you young men who have studied dentistry and have become proficient in the art should think the making of teeth to be the least of the purposes of your future life. As in surgery, dentistry is conservative, and you will serve man best if you will enable him to keep the teeth which nature has provided. The physician of the future as well as the dentist must be the arbiter of good health, and good health comes largely from good food and good hygiene; good food well masticated and good hygiene well applied.

The farmer furnishes the food, the dentist secures its mastication, and the physician formulates the laws of health and helps to restore to the normal any diseased organ of the body. The first thing, therefore, which the physician of the future must see to is the food supply, not that he is expected to till the soil and produce its fruits, but that he is to help in the great work of restoring foods to their normal state.

To what lengths have the arts of adulteration gone? There is no time to-night to preach to you about the awful evils of food adulteration, not only of its effect upon health, but of its demoralizing effect upon the honesty of commerce. It is a matter of which the medical profession of this country may be proud, namely, that as a unit they stand committed to the cause of pure food, to opposition to fake advertising, to the restoration of honesty in the trade in food products, and to the elimination from foods of drugs which are useful only in cases of disease. The great army of dentists also in this country stand in the same rank. They are aware, in fact, that if the functions of an organ are suspended the organ itself sooner or later suffers atrophy, loses its power of functional activity, becomes abortive in the course of ages and rudimentary. Thus the great professions of medicine and dentistry in the future will stand together to fight the evils of predigested and prechewed foods. Predigested food will cause the stomach to shrivel and become finally only a rudimental organ. Prechewed food will in the course of ages produce a toothless race. It is bad enough to lose one's hair, but for heaven's sake let us keep our teeth!

I do not care who makes the laws in this country if you will let me furnish the people with good teeth, nor who writes the songs if I can help to keep the stomachs in prime condition. It will be a sad day for humanity in the future when pepsin loses its savor and is furnished only by the chemist and not by the secretory glands of the stomach. See to it then that future generations have something to chew and something to digest, and to this great end much of the energy and ardor of the investigations of our future physicians and dentists must be directed.

The physician of early ages was a magician and necromancer. The medicine man of savage tribes is still practising the art of incantation. It is a far cry to Æsculapius, but before his day even disease was supposed to be the work of evil spirits. In fact the most destructive swine plague that we read about in the Bible was caused by the devils which were cast out of sick men, and these devils, taking possession of the swine, caused them to rush into the sea and be drowned.

The age of magicians in medicine was followed by that of the empiric, which was a great advance and led to the foundations of real science in medicine. The empiric we still have with us and always will have as long as man has idiosyncrasies. We can never tell in any individual case what the result of any certain treatment will be because we can never properly estimate the value of the individual idiosyncrasy.

Empiricism is one of the legitimate aids to science. A great inventor like Edison who wishes to find a certain property tries in logical sequence everything that is practicable, and often it is only after thousands of trials that the substance having the requisite quality is found. So empiricism in medicine is legitimately applicable when guided by scientific reasoning and sound principles.

The age of empiricism, however, was followed by the age of rationalism in medicine and it is on this basis that the science of medicine stands to-day. Perhaps I should not say science of medicine, but the art of medicine, because the art of medicine itself is based upon certain sciences, for instance, the science of anatomy, of physiology, of materia medica, of surgery. In fact there is not a science known to man which may not have some connection with the art of medicine.

If we look at the physicians of the present we find three classes have been founded as a result of rationalism in medicine: First, the general practitioner who of necessity must be brought in contact with all forms of human ills; second, the specialist who happily lives in a community where the physician who devotes his whole time to one particular study can be supported; third, the health officer who is the forerunner of the physician of the future.

The foes of rational medicine at the present time are, first, the quack, a man possessing, possibly, high medical training and skill, but unfortunately devoid of those principles of ethics without which the honorable practise of a profession is impossible; second, the charlatan, a man necessarily devoid of any medical training or ability, who plays upon the feelings of his patients and administers nostrums of no value and applied with no science. The third foe of rational medicine is the impersonal physician, namely, the nostrum, the patent medicine and the proprietary remedy. It is appalling to think of the thousands and thousands of our fellow citizens who pin their faith to these alleged remedies. Some of them have value; they are in fact often the very remedies which are described in the materia medica and the pharmacopœia and administered by physicians, but distributed as they are, with absurd claims of efficiency, taken as they are, without the advice or consent of a physician, they become not only one of the greatest foes of rational medicine, but one of the greatest dangers to the public at large.

I do not deny to the inventor who discovers a new remedy or a new combination of remedies the same right to profit therefrom which is accorded to the inventor of a new machine or a new process. The law protects the inventor of such a remedy and he can protect it by patent or by trademark, but it seems to me there is no excuse for the secret nostrums and no justification for the methods of advertising them. I know how difficult this problem is; I know what vast returns are received by the public press for advertising these bodies; I know how valuable the press is and I appreciate the great and good work which it does, but there is no justification for using the columns of the public press to deceive the public, to excite fears of dangers that do not exist and create hopes that can never be realized.

The physician of the future will see a growing preponderance of preventive medicine and the character of the profession in future years will be largely molded by the influence which this growth exerts.

The activity of preventive medicine will be shown first in the case of public and domestic hygiene. The laws of good living are fairly well known to but few people.

The public schools will surely become a medium of transmitting instruction in this line. Public sanitation in the course of its career may reach that abomination of contrivances in so far as offended hygienic conditions are concerned, namely, the sleeping car. It is difficult to imagine any contrivance which human ingenuity could construct better calculated to secure the best conditions for disease and the best methods for propagation thereof than the sleeping car. Constructed in such a way that ventilation is practically impossible; partitioned into small compartments, carefully curtained to prevent any circulation of air, if there should be fresh air; provided with enough heating surface to the cubic yard to complete the installation of a Turkish bath, and manned by porters to whom high temperature is an evidence of heavenly bliss, it is not difficult to conceive of the tortures to which the helpless passenger is exposed. These compartments often carry, without any precautionary inspection, persons in all stages of phthisis and even other contagious diseases. There is no health officer to inspect incoming passengers, no provision of the law requiring complete fumigation and no systematic appliance of any kind to prevent or eradicate disease. It has been claimed that the blankets are *washed at least twice a year*, as if that alone were a sufficient excuse for all of the dangers that exist! Perhaps, if one used the same blanket himself all the time he might not be justified in objecting to such frequent ablutions, but what right have we to ask if such a *careful* purification of a blanket used by a different person every night is based on any of the broad principles of hygiene or good taste?

The composition of the air in a sleeper filled with passengers, after a night of low temperature can better be imagined than described. It is true that no one is compelled to spend the night in these compartments, but the ordinary coaches are not much less objectionable, and thus the traveler is left only with the option of staying at home or walking to his destination.

The physician of the future will gradually teach the people the principles and necessity of public and private sanitation, for domestic hygiene is no less important than public. That dread scourge of humanity, consumption, will find its most effective foe in the establishment of true principles of hygiene both at home and in public places.

The medical profession of the future will also see extended and placed upon sounder scientific foundations the antitoxin theory of prevention and cure. The world owes a debt of gratitude to Pasteur and his co-laborers in this and other countries for establishing the foundation, on broad scientific grounds, of the idea that immunity may be artificially, as well as naturally, produced. Jenner was the forerunner of this great school of medicine, but his practise was absolutely empirical. Neither he nor his followers had any idea whatever of the manner in which vaccination renders the subject practically immune to smallpox. Advanced medical science has revealed the fact, however, that not only smallpox, but many other deadly diseases owe their toxic development to the compounds produced in the system chemically allied with the nitrogenous constituents of the body. The moment these poisons become dominant in the system nature makes an effort to eliminate them or to neutralize them. In other words, the toxic body is met and combated by the antitoxic body. One of the greatest triumphs of the science of chemistry has been the determination of the character both of toxic and of antitoxic substances and the development of the method of producing them both, especially the antidote. You have been fully instructed in the principles of this modern branch of medicine and know how closely your future professional activity will be connected therewith.

Perhaps it is not wise to prophesy a time when enzymic diseases shall lose all their terror by reason of the discovery of effective antidotes to the poisons to which their ravages are generally due. It is reasonable, however, to look forward to the time when the terror of these diseases, namely, diphtheria, typhoid fever, typhus and kindred scourges shall be reduced to a minimum.

If, as has been well demonstrated, the germ of typhoid fever is transmitted principally in water, there seems no reason to doubt the ability of health officers, collaborating with broad-minded municipal authority and high class engineering skill, to perfect means whereby this deadly germ shall be practically eliminated from our water supply. Consumption may be checked by the establishment of camps of detention where the unfortunate victims of this terrible disease may receive not only the highest degree of proficiency in medical treatment, but also be so segregated from the non-infected portions of the community as to render the spread of the disease difficult.

Moses himself was a sanitarian of no mean accomplishments and many of the principles established by him in sanitary science might well be exploited in modern times. The type of camp which he established for the detention of unfortunate lepers, well modified to suit modern principles, would serve for the check and practical elimination of consumption.

I realize vividly the effect of a mental nature produced upon people of highly sensitive constitutions and of an impressionable nature, such as the victims of phthisis usually are, in being made practically prisoners in an environment of misery and despair. This, however, is not a question of sentiment, it is a principle of existence. It is based upon the undoubted right of the healthy to be protected against the invasion of disease. Moreover, a detention camp might be made attractive in every way with beautiful gardens, sunshine, flowers, music and all the other agreeable arts of life, and thus the terrors of detention be robbed of their chief significance.

The physician of the future will, therefore, be the herald and exponent of prophylaxis. It seems a contradiction of terms to predict a future for a learned profession, which, if perfected, would rob the profession of all of its emoluments; but with the changed condition of the future physician a change in the character of his emoluments will also come. The medical profession, in other words, will not be paid in proportion to the amount of sickness which prevails, but rather in proportion to the degree of health which is maintained. That physician will have the largest compensation whose parish is freest from disease. He will become the teacher of the principles of public hygiene, as before mentioned, in the schools, colleges and hospitals; he will, in my opinion, become largely a public officer, and every state, city and town will have as one of its chief officials a medical health officer. Surely such an officer is quite as important to the welfare of the community as the assessor and tax collector. The physician of the future, therefore, will become more and more active as a citizen and take a more lively interest in public affairs.

I have looked carefully over the congressional directory of the Fifty-Seventh Congress and find that the congress of the

United States contains 319 lawyers, 93 business men, 32 politicians, 12 editors, reporters and newspaper writers, 8 farmers, 3 teachers, 1 clergyman, 1 military man and 3 physicians. Does it not seem strange that the great law-making body of our country should contain so few members of this learned profession? Think for a moment of the amount of legislation in which sanitary matters are involved! It is acknowledged by all that the building of the Panama Canal is more a sanitary problem than it is an engineering one. The men who really build the Panama Canal will be the physicians and health officers who eliminate from that infected locality the germs of malaria and infectious diseases. If the canal fails it will not be for lack of dredges nor shovels nor picks nor machinery nor money; it will be due to the ravages of cholera, of yellow fever and of other malarial diseases.

The importance of the quarantine service has not been fully recognized. The exclusion of disease is the easiest way to fight it. The splendid work of the Public Health and Marine Hospital Service is one of the things which the national legislator should carefully support.

The legislation relating to pure food is a matter of the utmost sanitary importance. The regulations of interstate commerce which omit the sanitary conditions which have been previously outlined are altogether incomplete. In fact it appears that a very large proportion of our legislation which really concerns the public welfare should be accomplished with the advice, the vote and consent of the medical profession, and yet out of more than 400 members of the national congress only three have had any medical training. The congress of the future will contain not less than 1 per cent. of trained medical men, but let us hope as much as 25 or 30 per cent. Again, there is no reason why a medical training should unfit a man for other duties in connection with public life than those relating to sanitary measures. I can see no reason why a physician should not make a good president as well as a good major general, a good governor or a good mayor, a good member of the common council and especially a most excellent commissioner of sewers. We wish the future to see the entry of medical men into public life and the assumption by them of all duties of a nature which relate to the public welfare. I can see no reason why lawyers should predominate in our national congress any more than that physicians should hold the balance of power. Perhaps I can not better illustrate this idea than by quoting from that master of political craft, that learned and erudite statesman, ex-Senator David Turpie, who says in his book, entitled 'Recollections of My Own Times,' in speaking of Senator Dr. Graham N. Fitch:

> Fitch was the only physician who ever served from Indiana in the United States Senate. I have latterly reflected somewhat upon this solitary instance. Years ago we used to send a good many of our physicians to Congress. He, himself, was one of these, and there were several others, among whom I recall Dr. John W. Davis, of Carlisle, in the county of Sullivan, whom I knew quite well. He was the first Indianian chosen to the position of speaker of the House at Washington and was accounted the best parliamentary jurist in the country, perhaps in the world. His rulings were quoted as authority in the English House of Commons and more than once in the legislative chambers of France. Upon his voluntary retirement from Congress he was appointed minister of the United States to China; served with distinction among the polished diplomats of the Orient, and returned to accept the appointment of governor of Oregon. He was the first American civilian of official note and station to make the trip homeward from the east by way of the Pacific. His voyage across the ocean lasted several weeks. I have heard that the account of it, then no twice-told tale, was a story of thrilling, almost tragic interest.

In these later times our practitioners of the healing art seem studiously to avoid the cares and labors of political life. Occasionally you may meet a physician in the legislature—even this, as some of their caste say, is unprofessional—but as a body they appear to prefer the position of outfielders in this arena. There are two notable characteristics of the active and skilled physician—a close observation of detail and a deft attention to the matter in hand—the duty of the hour, of the moment. These qualifications are admirably suited to the requirements of public life. No more favorable hope can be expressed for the future than that the members of this great profession will again resume an active interest and prominent position in the political affairs of the state and nation.

The physician of the future will have no easy berth, for, in his profession, as in all others, fitness, tact, erudition and industry must win the way. The sluggard, the ignoramus and the indifferent must fall by the wayside.

The number of people entering the medical profession is probably too great. In the United States of America, including the Philippines, Porto Rico and Hawaii, there were in 1901, 115,222 physicians in a population of 84,332,610. The last complete data we have concerning the number of attendants in medical schools are for 1899. In this year there were, excluding graduate schools, 156 medical schools in the United States with 24,119 students. The growth in the number of medical students in twenty-one years has been 142 per cent.

In addition to these undergradute schools there are eight graduate medical schools which had (in 1895) 624 instructors and 1,813 students, of whom 59 were women.

In Germany the conditions are quite unsatisfactory and the overcrowding of the medical profession in that country is a matter of grave concern. There are now in the empire 29,200 physicians, which doubles the number found in 1876. In other words there is one physician in Germany for every 1,700 inhabitants. In the city of Berlin 46 per cent. of all the physicians have an income of less than $700, and five per cent. of the whole number do not have a sufficient income to return it for taxation.

On the other hand, in the legal profession in Germany 80 per cent. of the lawyers have an income exceeding $2,000.

It is estimated that the preparation of a man for the duties of a physician in Germany costs about $6,000, and thus it is seen that the income is often less than 10 per cent. of the fixed charge on the capital invested. This leaves practically nothing for the reward of his own personal services, nor for wear and tear.

What are to be the remedies for this condition of affairs in the future? Shall the physicians organize a union and admit only a certain number of apprentices each year, or shall they have the requirements for admission, when properly applied, exclude all those who are not extremely well prepared? In the great school of the Beaux Arts in Paris the number of admissions is strictly limited and, perhaps, the great world school of medicine will have to come to this condition of affairs. In fact, an approach has been made already in at least one great medical school of this country, and candidates for the degree of doctor of medicine are not admitted until they hold a previous degree of an academic character or study equal thereto equivalent to the course of study required for the ordinary degree of bachelor of arts. The effect, however, which was anticipated in this particular instance was not realized. Indeed, there was at first a diminution in the number of students in attendance, but, attracted by the greater fame which a degree from such an institution would afford, this condition was gradually overcome and the actual number of attendants became greater than when admission was easier.

This is indeed a serious question. I doubt if the charge for medical services in the country can be much larger than $1.00 per head, and it is thus seen that the 115,000 physicians of this country must be content to divide among them a paltry income of less than $90,000,000 at the present time.

Finally, the physician of the future will find his greatest service in prolonging human life. I am not here to claim that human life is so valuable that it needs always to be prolonged. This may not be so from the general economic condition of affairs, but, personally, I think we are all more or less interested in longevity. It can not be denied that there is a distinct economical gain in putting a man out of the world after he has passed his prime and before be becomes a burden upon his friends or the community. The asylum and the poorhouse are not to be regarded as shining lights of advanced political economy, but there is something in life besides mere political economy, and the prolongation of existence is regarded as one of the chief functions both of the medical profession and of public charities.

On the other hand, it must be considered that there is a distinct economical loss in cutting off from existence a man before he has run the full course of his career. To train a man for usefulness requires now fully a quarter of a century, and it seems only fair that he should have at least twice that time for the manifestation of his activities. If, therefore, he be cut off at thirty-five, forty or forty-five, the community is robbed of service to which it is entitled.

If old age could be secured without much of the burden now attending it, there would be the gradual ripening and mellowing of all the functions of the body and mind. If, in short, the human organism could be so constructed and cared for that it would continue its functional activity like the wonderful 'one hoss shay' until the time of its final dissolution, such a consummation is devoutly to be wished.

The medical profession of the future will find its best exponent in the service of senectitude. An old age without illness or dementation, a ripening without decay, a completion of the functional activity without the breaking down of any organ are steps toward which the medical profession of the future may well direct its energies.

Death should not be regarded as a misfortune, but as an end, as a termination of a journey which has been filled with delight, as a rest for weariness which comes with the natural order of labor, as an euthanasia and not a dreadful disaster.

H. W. Wiley.

U. S. Department of Agriculture.

PROCEEDINGS OF THE CENTRAL BRANCH OF THE AMERICAN SOCIETY OF ZOOLOGISTS.

The third annual meeting of the Central Branch of the American Society of Zoologists, and the sixth annual meeting of the society since its original establishment was held at the University of Chicago, March 31 and April 1, 1905.

The following having received the votes of the executive committees of both branches were elected to membership in the central branch: James Francis Abbott, Bennet M. Allen, Lawrence Edmunds Griffin, Lynds Jones, C. E. McClung, George Wagner, L. M. Walton, Samuel L. Williston, Charles Zeleny.

The bill on vivisection before the Illinois State Legislature was discussed and it was

Voted, That this society concur in the following resolution and instruct the secretary to communicate this action to the Central Branch of the American Society of Naturalists:

Resolution: "It having come to the attention of the Central Branch of the American Society of Naturalists that a bill has been introduced into the Illinois State Legislature which would restrict the freedom of scientific investigation in Illinois,

"*Be it Resolved:* That the members of this society protest against such legislation as is contemplated in Senate Bill No. 271, because it is inimical to the interests of science and would seriously obstruct the advance of knowledge concerning the nature and cure of disease in man."

The officers elected for the ensuing year and those holding over are as follows:

President—Frank R. Lillie.

Vice-President—William A. Locy.

Secretary-Treasurer—C. E. McClung.

Additional Members of the Executive Committee—C. H. Eigenmann, for three years; Herbert Osborn, for two years; Thomas G. Lee, for one year.

The following are titles and abstracts of papers presented at the meeting:

The Origin of the Sex-Cords and Rete-Cords of Chrysemys: Bennet M. Allen, University of Wisconsin.

In an early stage of development (embryo of 7 mm. total length), each of the more ventral Malpighian corpuscles of the mesonephros is still attached to the peritoneum by a neck of cells which sometimes possesses a lumen and constitutes a peritoneal funnel. There are usually four, sometimes three, such Malpighian corpuscles in each somite. A peritoneal ingrowth arises either directly from the base of each peritoneal funnel or just mediad of it. These ingrowths are termed funnel sex-cords. Other sex-cords arise from the peritoneum between the funnel sex-cords and the mesentery. These anastomose with the funnel sex-cords which in turn unite with evaginations from their corresponding Malpighian corpuscles after the latter have broken away from the peritoneum. The bridges thus formed between the funnel sex-cords and Malpighian corpuscles constitute the rete-cords which are thus formed from the distal portions of the funnel sex-cords plus evaginations from the Malpighian corpuscles. The foregoing applies to the sex-gland along its entire length.

The distal ends of all the funnel sex-cords and of many of the other sex-cords contribute to the formation of the adrenal bodies.

The anterior portion of the sex-gland of the turtle is homodynamous with the rete region of the genital ridge of the mammals (pig and rabbit).

Further Notes on the Chromosome Complex of Orthopteran Spermatocytes: C. E. McClung, University of Kansas.

A careful study of a large number of species indicates that the members of a family possess a common number of chromosomes. In each species there is found a characteristic series of chromosome forms, and these are in many cases peculiarly associated. In some cases the grouping is characteristic of the genus, and within the genus the species are marked by variations in size of chromosomes and other parts of the cell. Heterotypical mitoses occur in spermatogonia, first spermatocytes, and second spermatocytes, and in each case witness a longitudinal division of the chromatin thread. In the spermatocytes all the chromosomes do not divide in the same manner. These irregularities of association and division are largely due to the action of the accessory chromosome, which in some cases unite with the one tetrad, forming a trivalent element, and in others with two tetrads, producing a pentivalent mutiple chromosome. From these observations it is concluded that generic and specific characters are the result of differences in size and associations of chromosomes, and not to variations in numbers. It is also thought that continuous variation may be due to slight differences in size of the chromosomes of the germ cells, while discontinuous variation would be due to alterations in the relations of chromosomes to each other.

Regeneration in Nudibranchs: C. M. CHILD, University of Chicago.

Several species of æolids abundant in the Pacific Grove region were used for experiment.

It was found that removal of a portion of the body posterior to the middle was followed by rapid regeneration. The larger the portion removed the more rapid the regeneration.

The ganglionic mass is situated posterior to the second pair of tentacles; removal of the whole head anterior to the ganglia was followed by rapid and complete regeneration. When the ganglia were removed no regeneration beyond healing of the wound occurred, though the animals often lived for two weeks.

Regeneration of posterior portions of the body was less rapid in specimens from which the head anterior to the ganglia had been removed than in specimens with uninjured head. The specimens from which the head region had been removed had lost their principal sense organs, but still retained the central nervous system intact. They were much less active than specimens with normal heads and the posterior parts were consequently subjected in much less degree to the conditions accompanying functional activity of this region; hence in all probability the less rapid regeneration. After the new head regenerated, posterior regeneration in these pieces was fully as rapid as in those with uninjured heads. Removal of other portions of the body such as the lateral regions of the foot, etc., had no effect upon the rapidity of posterior regeneration.

If the animals are not fed a marked reduction in size, often 50 per cent., occurs in the course of two or three weeks.

The Relation of the Degree of Injury to the Rate of Regeneration: CHARLES ZELENY, Indiana University.

Two series of the crayfish, *Cambarus propinquus*, differing only in the degree of injury which they had sustained, were compared with regard to the rate of regeneration of the right chela and the rate of moulting. In one series, AA_2, the right chela was removed at its breaking joint. In the other series, BB_2, both chelae were removed at their breaking joints and the last two pairs of walking legs were likewise removed. Series AA_2 comprised 36 individuals and series BB_2 41 individuals.

A comparison of the two series was made 95 days, 130 days and 153 days after the operation. In each case the data show very definitely that the series with the *greater* injury molts *sooner* than the one with the *lesser* injury and also regenerates *each* of its two chelæ more rapidly than the latter regenerates its *one* removed chela.

Experimental Evidence Concerning the Production and the Preservation of Acquired Characters: W. L. TOWER, University of Chicago.

Dominance; a Potent Factor in the Extinction of Species: W. L. TOWER, University of Chicago. Read by title only.

The Origin and Distribution of Tropical American Fresh-water Fish: C. H. EIGENMANN, Indiana University.

The Sequence of Organisms in a Protozoan Culture and its Irreversibility: AMOS W. PETERS, Zoological Laboratory, University of Illinois.

A definite procedure is followed in the setting and care of protozoan cultures with a medium of hay infusion. The seed here used came from previous laboratory cultures or from field collections. The physiological conditions are determined at almost daily intervals by physical and chemical methods. Evidence so obtained points to fermentative action as the beginning of metabolism in the culture. The curve for acidity is of much physiological significance. An approximate method of estimation is used to compare the relative abundance of the different organisms and the results are represented by curves. Relative curves have been approximately determined for bacteria, *Colpidium, Paramœcium, Amœba,* some *Hypotricha, Arcella,* some Rotifera and *Stentor*. All efforts to change well-defined curves to decidedly different relative positions in the history of the culture have failed. The maxima of the curves can not be interchanged by reseeding. Since reseeding was not practised (except for experiment) the cysts or spores of all the organisms found must have been continually present. Mutual antagonism of the different forms is not a probable explanation. The serial succession of the organisms and the parallel physicochemical changes in the environment point to *specific adjustment* as a probable hypothesis. The determination of some of the specific adjustments of *Paramœcium* and *Stentor* supports this hypothesis.

An Analysis of Physiological Conditions in a Protozoan Culture: Amos W. Peters, Zoological Laboratory, University of Illinois.

The influence of the physiological states of protozoa in producing variations from a supposed standard is seen in the results of experiments upon both the directional and the metabolic reactions of this group. To obviate this important difficulty the writer proposes to standardize the given conditions of any culture. Standardization of the conditions, if successful, uses the peculiarities of the physiological states for a more accurate interpretation of the results of experiment, instead of leaving these states as objectionable factors in an experimental procedure.

The methods to be used must conform to at least two conditions. First, they must not require more than a small amount of culture liquid (5 to 10 c.c.) for a test, in order that serial observations can be made upon the same culture. Second, they must be sufficiently accurate and sensitive to yield results that show the successive small differences which occur in the history of a single culture. The special methods here applied are mostly volumetric and comprise the determination of: (1) Qualitative chemical content, (2) free acidity or alkalinity, (3) dissolved oxygen, (4) bicarbonates, (5) alkali earths, (6) electrical conductivity, (7) oxygen consumed, (8) sulphated nitrogen, (9) ammoniacal nitrogen, (10) individual salts—nitrites, nitrates, chlorides, potassium, calcium, etc. For both convenience and accuracy, a system of standardizing all the necessary volumetric solutions in terms of one original standard acid has been devised. By these methods one series of data has been taken from various media promiscuously selected for comparison, and another series comes from the history of single cultures. In both series the biological aspect of the media was known. Comparison of the physicochemical and the biological data indicates that variations in the former are an approximate expression for corresponding changes in the physiological states of the organisms. The methods here selected are therefore serviceable for the physiological estimation of the protozoan environment.

The Evolution of Color Characters: R. M. STRONG, University of Chicago.

Color characters are purely relative means of distinguishing various individuals or groups of animals, and their significance varies according to the experience and knowledge of the observer. In birds, color characters are all connected by series of transitional stages which appear perfectly continuous even after careful analysis, and the most highly developed characters may be found in incipient stages not ordinarily observable. A study of the colors of birds has led the writer to believe strongly in an orthogenetic theory of evolution of color characters by continuous variation in birds.

Some Observations on the Litoral Fauna of Pacific Grove, Cal.: C. M. CHILD, University of Chicago.

The Entomological Ecology of the Indian-corn Plant: S. A. FORBES, University of Illinois.

This paper consists of material in pure ecology selected from the mass of matter accumulated in the course of several years' study of the corn insects from the economic point of view. It deals with adaptive relations of the corn insects to their food plant and to one another; classifies adaptations of insects to their food as structural, physiological, psychological, local, biographical and numerical, giving illustrations of each class; discusses the adjustment by natural selection of the life histories of insects dependent upon the same plant; analyzes examples of competition among such insects; refers to the agency of natural selection in transforming competitions from the simultaneous to the serial order; and theorizes the whole subject by reference to the general principle of a community of interest between a phytophagous insect and its food plants.

The Fauna of Mayfield's Cave: ARTHUR M. BANTA, Indiana University.

Mayfield's Cave is a small cave near Bloomington, Ind., which presents typical cave conditions having a nearly constant temperature and conditions of light shading from twilight to absolute darkness. Eighty-seven species of animals were taken in this cave as against 68 heretofore known from all of the Indiana caves. Of the 87 species but 21 are permanent residents and only 8 are found in caves exclusively. Species including diptera, lepidoptera (2 species), arachnida and the bats hibernate in the cave in considerable numbers. Each cave inhabitant sustains a certain definite relation to the light, some living only in absolute darkness, others in dim twilight, etc. Aside from conditions of light and temperature, the distribution of cave animals is influenced by moisture, the presence of organic matter which serves as food and the presence of means of concealment. Some of the highly modified and truly cavernicolous forms are occasionally found outside of caves in springs, about wells, in drains and in similar situations. Change of seasons has little influence upon cave life. Species which are only temporary residents and some of the less highly specialized of the permanent residents are young and local cave forms, while the highly specialized cave inhabitants such as the blind fish, blind cray-fish and the blind carabids are old and widely distributed cave forms. The nearest relatives of cave forms are nocturnal or are dark or shade-loving species, while the food and habits of cave species are exactly similar to the food and habits of their near relatives living in other situations. The habit of hiding under loose stones and other debris persists in many cave forms where the habit is apparently altogether useless. *Cambarus bartoni* living in the cave possesses less pigment, and their antennæ are eleven per cent. longer compared with individuals of the same species living outside.

Guinea-chicken Hybrids: MICHAEL F. GUYER, University of Cincinnati.

These hybrids, five in number, were produced by crossing a black Langshang cock with a common guinea hen. When young the hybrids resembled more young guineas, although the shanks were feathered, as were those of the father. Traces of these feathers still (nearly three years later) persist. The hybrids are much larger than guineas and have louder and even more discordant voices. They are extremely wild. The head shows no trace of either the comb of the chicken or the helmet of the guinea, but is covered with feathers clear to the beak. Neither are wattles nor earlobes present. The beak, in color and shape, resembles more that of the guinea. A trace of the guinea's white face is discernible in the hybrid in the immediate region of the eyes. The neck is very long and snake-like. The feathers are more or less intermediate in structure between those of the parent forms. The tail is erect and never droops like that of the guinea. The large quill feathers of tail and wing not infrequently possess vanes which are black on one side of the rachis and more like the hybrid general plumage on the other. The first one to three primaries are white in all of the hybrids. Guineas frequently show similar white primaries. The color of the head and neck is mainly black, although in two of the forms, there is a decided sprinkling of white feathers in this region. The general ground color of body, wing and tail plumage is dark gray in three of the hybrids, but in the remaining two it verges more toward a chestnut color. In all, the feathers are crossed by narrow lighter colored V-shaped bars which gives the plumage, on the whole, a decidedly barred appearance. The conspicuous white dot of the guinea's plumage seems to be entirely lost. There is, however, a secondary inconspicuous barring in many of the features of the guinea which possibly may be the source of the bars of the hybrid. The forms have not proved fertile and the chief interest in them will center in the chromosomal structures of the germ cells. At present there is no means of telling their sex.

Notes on Cross-bred Chickens: MICHAEL F. GUYER, University of Cincinnati.

Barred or white Plymouth Rocks and brown Leghorns were used in crossing. There is much question regarding the exact ancestry of Plymouth Rocks, but undoubtedly the American Dominique and the black Java are the main sources, with probably also a considerable admixture of Brahma blood. The brown Leghorn of to-day appears to be the descendant of an old breed of fowls introduced from Italy in 1834.

The offspring, 400 in number, of brown Leghorn ♂ × Plymouth Rock ♀ were every one black, except for an occasional feather of reddish hue in some of the cocks. While in plumage they thus seem to revert to the ancestral black Java, this is not so true of shape and weight, which varies in all degrees between that of the two parent types. The white ear lobes of the Leghorn always persist. Some of the progeny, indeed, resemble black Minorcas very closely. Most of them have the dark slate-colored shanks that commonly accompany black fowls, although about 30 per cent. are yellow shanked. The comb is the most variable structure, exhibiting 3 or 4 to 7 serrations. Not infrequently double combs (two single ones side by side) appear in the cocks. Various crosses among the members of this generation and between them and the parent stocks were made, but the limits of an abstract will not permit record of these results. On the whole, no characters observed, appeared to follow the laws of Mendel with any accuracy. For example, black × black have invariably produced black offspring, so far with the white ear lobes persisting. A black ♂ × barred plymouth ♀, among others, produced one male offspring which rather closely resembles a dark Brahma cock.

Pure white Plymouth Rocks which always produced white offspring when bred together, never produced white offspring when crossed either way with brown Leghorns, nor did any of the mongrel offspring, when interbred. The majority of the offspring were barred, the remainder being nondescripts or occasionally black. Interbreeding this generation resulted in the production of several fowls which were of a pure barred Plymouth Rock type except for the persistent white ear lobes of Leghorn origin.

Observations on some Peculiar Habits of the Mole-crickets: W. J. BAUMGARTNER, Kansas University.

The *female* of our northern mole-cricket, *Gryllotalpa borealis,* has quite a loud and distinct chirp. This seems to be used as a means of recognition in their dark burrows. This observation is contradictory to the conclusion of all writers who say only male orthoptera chirp, or stridulate. The female of the Porto Rican species *Scopteriscus didactylus* has the same kind of a stridulating organ (much smaller and weaker than that of the male) on its elytra, and so I conclude it also chirps.

Du Four's gland of 'excretory secretion,' which later investigators have connected with the copulatory organs, is by my observations and experiments shown to be an effective protective device. A strongly *fœtid* and very *sticky* secretion is ejected with considerable force from the siphon-like genito-anal opening. This must repel or retard the most ardent pursuer and so protect the soft abdomen from the rear.

In the act of copulation these insects assume the relative positions suited to their tunnel-like homes. They turn posterior end to posterior end and ventral side to ventral side, the male lying on his back. The sperm is transferred in a *spermatophore. Scopteriscus* has a similar protective gland, but its copulation was not observed.

The chirping of the female, the protective anal secretion and the unusual position of male and female in copulation which distinguish the mole-crickets from the rest of the orthoptera are very evidently adaptations to life in underground tunnels. The presence of the spermatophore accounts for the annexed glands in the male *Gryllotalpa.*

The Reflex Theory of Orientation as Applied to the Phototaxis of Ranalia: S. J. HOLMES, University of Michigan.

A Note on the Position of the Temporary Pharynx in the Planarian Embryo: W. C. CURTIS, University of Missouri.

Mattiesen in his extensive account of the embryology of the European *Planaria torva,* which has been recently published in the *Zeitschrift für Wissenschaftliche Zoologie* ('04), suggests that my description of the orientation of the adult and embryonic pharyngeal structures in *P. maculata* must have been due to the examination of a single abnormal specimen or to distortion caused by poor fixation. My observation has been confirmed by Bardeen ('02); and in another American form, *P. simplicissima,* Stevens ('04) believes the same orientation to exist, although in this case the early disappearance of the primitive or embryonic pharynx makes the matter difficult to establish. Mattiesen finds that in *P. torva* the adult pharynx appears just behind the degenerating embryonic pharynx, which is, therefore, located on the future ventral part of the body as the spherical embryo becomes flattened. This confirms Ijima's ('84) description of the orientation in *Dendrocœlum lacteum.* In *B. maculata* the point at which the degenerating embryonic pharynx is last seen is on the dorso-posterior surface.

The Arrangement of the Mesenteries in the Cerianthidæ. J. Playfair McMurrich, University of Michigan.

In 1892 Faurot observed that the mesenteries of *Cerianthus membranaceus* were arranged in groups of four, each quartet consisting of a longer and a shorter fertile mesentery alternating with a longer and a shorter sterile one, and his observation was subsequently confirmed by van Beneden for *C. Lloydii.* Both authors regarded the quartets as beginning with the fourth mesentery on each side of the mid-siphonoglyphic line. The study of the development of the cerianthid mesenteries has shown, however, that the first four mesenteries on either side of the mid-siphonoglyphic line constitute a group distinct from the others and are comparable to the eight protocnemes of the other groups of Anthozoa.

Among the 'Siboga' actinians is a species from Amboina, probably *C. elongatus* Kwietn. In this form there is on either side of the mid-siphonoglyphic line the usual short sterile directive mesentery, then follow two additional sterile mesenteries, and then a long fertile mesentery which extends almost to the aboral pole of the body. This last is apparently the so-called *continuous mesentery*, and the interest of it lies in the fact that it is the fourth mesentery and not the second, as in all other species that have been examined. This departure, which occurs in all the individuals of the species examined, corroborates the view based on the developmental history that the four mesenteries on either side of the mid-siphonoglyphic line constitute a group apart from the rest, and that the quartets should be regarded as beginning with the fifth mesenteries.

An Improved Form of Reconstruction Apparatus: Thomas G. Lee, Laboratory of Histology and Embryology, University of Minnesota.

Doctor Lee presented a very satisfactory form of reconstruction apparatus, which he had designed and which is an improvement over the models now in use. It consists of a cast-iron bed plate 8½ cm. (3¼ inches) thick at sides, and 4½ cm. (2 inches) thick in the middle. The top measures 23 x 30 cm. (9 x 12 inches), and has been accurately planed and polished, giving an area of 690 sq. cm. (108 sq. in.). The side pieces, by which the thickness of the wax plate is determined, are moved up an inclined plane which is rigidly fastened to the bed plate in a manner similar to the movement of the object holder in a Thoma microtome. All parts of the top of each side piece are thus always in the same plane. The side piece is moved up and down by a large and accurately made screw at the rear of the apparatus. After adjustment the side pieces can be firmly fixed in place by two set screws by means of a small wrench. A metal scale is placed on each side piece, so that any thickness of wax plate can be made from ½ mm. up to 1 cm. at ½ mm. intervals. Thus plates of ½, 1, 1½, 2, 2½ mm., etc., can be made. Projecting from the bed block are two metal strips with a depression to hold the roller when not in use. This whole apparatus weighs about 67 pounds, and is quite rigid.

The roller is of polished steel 30 cm. (12 inches) long by 6 cm. (2½ inches) diameter, with a steel rod projecting at each end and covered by a movable wooden handle. This roller weighs 17 pounds, but works very easily, indeed.

The heating apparatus consists of a metal frame supporting a copper jacket which has a concavity on its upper surface just a little larger in diameter than that of the roller. This protects the surface of the roller from contact with either the metal or flame. This concavity could easily be changed into a hot water bath for the roller, if so desired. The lamp is a horizontal Bunsen burner tube with numerous small openings. The roller does not require to be heated between each pair of plates, and thus when not in use it is readily rolled up into the support in front of the bed plate.

This whole apparatus is very solid, compact, accurate and easy to adjust.

Some Abnormalities of Growth Produced by Parasites on Alcyonaria: C. C. NUTTING, State University of Iowa.

In their 'Report on the Alcyonaria of the *Challenger* Expedition,' Wright and Studer described a new genus, *Calypterinus,* giving as a generic character a certain tunnel-like structure formed by excessively enlarged spicules, the tunnel being along one side of the stem or branch. Later Studer, in reporting on the Alcyonaria secured by the Prince of Monaco's yacht, declares that this peculiar structure is due to the presence of an annelid, and is pathological in fact. A similar structure was found by the writer in a species of *Tenella* secured by the *Albatross* from Hawaiian waters. The tunnel-like structures, with the annelids inside, were shown by means of lantern slides.

In a new species of *Dasygorgia* from the same collection the writer found certain very greatly enlarged polyps which at first looked like a form of dimorphism hitherto unknown. Upon dissection, however, these monstrous polyps were found to contain, without exception, minute crustaceans, either embryos or some form of degraded parasite. These were also shown by means of lantern slides from photographs made by the author. It appears that we have here a condition of affairs in an animal organism which bears a close analogy to the production of 'galls' in vegetable tissues.

The Origin of the Subclavian Artery in the Chick: WM. A. LOCY, Northwestern University. (Based on the work of Mr. Sabin.)

The subclavian artery in birds lies ventral to the vagus nerve and vena cava; in mammals it occupies a dorsal position with reference to those structures. On this account the subclavian arteries do not appear to be homologous as to origin in these two classes of vertebrates. Hochstetter was the first in 1890 to clear the question by showing that the definitive subclavian in birds is of secondary origin. Prior to its appearance there is a vessel arising from the dorsal aorta, opposite the 15th mesodermic somite, which supplies blood to the wing-bud from the third to the sixth day of development. On the sixth day the secondary subclavian arises from the ventral end of the third aortic arch. This new vessel passes backward and joins with the primary subclavian artery, coming from the dorsal aorta, and, from the sixth to the close of the seventh day of development, the wing bud receives blood from the two sources. The primary subclavian then disappears and the secondary subclavian remains as the permanent one.

Mr. C. G. Sabin, a graduate student in Northwestern University, has traced with great care the embryonic history of the subclavians in the bird and has illustrated the same. His results agree closely with those of Hochstetter, except that he finds the primary subclavian in earlier stages than Hochstetter, and observes that in the early condition the subclavian arises independently of the segmental arteries, with which, however, they join later. The illustrations which Mr. Sabin gives of the actual condition of the developing subclavian arteries were very much to be desired, since Hochstetter's paper was illustrated only by a few simple diagrams. The results are now published in the *Anatomischer Anzeiger*, Vol. 26, Nos. 11 and 12, with 29 illustrations.

The following demonstrations were made before the society:

1. William A. Locy, Northwestern University, 'Dissections Showing the Nervus Terminalis in *Scyllium, Trygon* and other Selachians.'

2. William S. Miller, University of Wisconsin, 'Demonstration of the Lymphatics of the Lung and Stomach in *Necturus.*'

3. Bennet M. Allen, University of Wisconsin, 'Models showing the Origin of the Sex-cords and Rete-cords in *Chrysemys.*'

Frank R. Lillie,
Secretary.

SCIENTIFIC JOURNALS AND ARTICLES.

The April-May number of *The Journal of Geology* contains an article on 'The Zuni Salt Lake' of western New Mexico, by Mr. N. H. Darton. It is illustrated by two maps and three half-tones. Mr. Douglass W. Johnson reviews 'The Tertiary History of the Tennessee River' and concludes that it has followed its present course through Walden Ridge for a long time, 'probably since the close of the Cretaceous period at least.' This article is illustrated by nine figures. Professor B. Shimek contributes an 'Additional Note on *Helicina occulata,*' a recent species, which also occurs as a fossil in the loess, and concludes that it supports the view that 'during the deposition of the fossiliferous loess the climate was not glacial.' Mr. Rollin T. Chamberlin describes 'The Glacial Features of the St. Croix Dalles Region,' which is illustrated by three sketch maps. Professor Stuart Weller describes 'A Fossil Starfish from the Cretaceous of Wyoming,' which he names *Pentagonaster browni.* Mr. O. W. Willcox contributes an article on 'The So-called Alkali Spots of the Younger Drift-sheets,' which are patches of white efflorescence which 'consist of small amounts of sodium chloride and much larger amounts of the carbonates and sulphates of magnesium and calcium.' Mr. George C. Matson has a paper on the 'Peridotite Dikes near Ithaca, N. Y.,' in which he describes several new dikes in addition to those noted over sixty years ago by Vanuxem and much more recently by Professor Kemp, and Mr. Wallace W. Atwood describes the 'Glaciation of San Francisco Mountain, Arizona.' This article is illustrated by a sketch map of the top of the mountain and it is stated that these records 'may possibly be those of the southernmost ice which existed in this country during the Pleistocene period.'

To the *American Geologist* for April Professor Eugene A. Smith contributes a 'Biographical Sketch of Henry McCalley' with portrait. Professor Warren Upham has an article on 'The Nebular and Planetesimal Theories of the Earth's Origin,' in which he quotes at length from Dr. T. C. Chamberlin's recent paper on the planetesimal hypothesis. Professor Upham also quotes from Dr. G. K. Gilbert's paper on 'The Moon's Face' and concludes that his explanation of the origin of the very abundant small and large crateriform features of the moon seems largely identical with Chamberlin's hypothesis 'so far as that hypothesis deals with the segregation of the originally nebulous matter to form planets and satellites.' Professor J. W. Spencer reviews 'Dr. Nansen's Bathymetrical Features of the North Polar Sea, with a Discussion of the Continental Shelves and the Previous Oscillations of the Shore Line.' Mr. Spencer says that while this memoir 'treats of the physiographic features of the Polar basin, yet the greater part is devoted to the investigation of continental shelves, not merely of the Arctic basin, but also those of the Atlantic, in which respect it is the most important work that has appeared anywhere. 'Professor

Shimek's criticism of the aqueous origin of Loess' is answered by Professor G. Frederick Wright. Mr. Paul W. Prutzman discusses the 'Chemistry of California Petroleum,' and the number concludes with an article by Professor Lawrence M. Lambe, 'On the Tooth-Structure of *Mesohippus westoni* (Cope),' which is illustrated by one plate giving four views of an upper molar of this primitive species.

The American Naturalist for March contains the following articles: 'The Anatomical Changes in the Structure of the Vascular Cylinder, Incident to the Hybridization of the Catalpa,' by D. P. Penhallow; 'The Occurrence and Origin of Amber in the Eastern United States,' Arthur Hollick; 'Fresh-water Rhizopods from the White Mountain Region of New Hampshire,' J. A. Cushman and W. P. Henderson; and 'The Reactions of the Pomace Fly (*Drosophila ampelophila* Loew) to Light, Gravity and Mechanical Stimulation,' by F. W. Carpenter. There are, besides, reviews of scientific literature.

ARTERIOSCLEROSIS in its relation to diseases of the nervous system is the subject of the opening paper in the May issue of the *Journal of Nervous and Mental Disease*. Dr. E. D. Fisher discusses the clinical aspect, and Dr. Harlow Brooks summarizes the pathology, with reports of three illustrative cases, one of syphilis of the cerebro-spinal axis, one of arteriosclerosis of the brain and spinal cord occurring in alcoholism, and one of acute arteritis occurring in vessels of the central nervous system in rabies. Drs. W. G. Spiller and C. H. Frazier follow with the presentation of some original views on the subject of nerve anastomoses. They have experimented in this line in the treatment of cerebral palsies, and their suggestions open up a field in neurological surgery that seems to be full of promise. Dr. Spiller also contributes a short illustrated paper, being mainly the report of a case which came under his observation and seemed to offer valid evidence for the location of the fibers of temperature and pain within the tracts of Gower. Dr. Jas. W. Wherry writes on the curability of epilepsy, and takes an optimistic view of the question, conditioned on beginning treatment promptly upon the appearance of the disease. His idea of the requirements in such treatment consists of 'A study of each case individually; special adaptation of drugs to individual conditions; personal supervision and individualization of diet, absolute change of environment.' The proceedings of the New York Neurological Society for December 6, 1904, and of the Philadelphia Society for December 27, 1904, are reported.

SOCIETIES AND ACADEMIES.

THE IOWA ACADEMY OF SCIENCES.

THE nineteenth annual meeting of the Iowa Academy of Sciences was held in the chemical lecure room of Iowa College at Grinnell, Ia., April 20 and 21. The following papers were presented:

B. SHIMEK: President's address, 'Botany and Intelligent Citizenship.'

C. C. NUTTING: 'The U. S. S. *Albatross* and its Work' (illustrated with lantern slides taken by the author).

L. S. ROSS: 'Apparatus for Plating Out Petri Dishes in the Field.'

BRUCE FINK: 'Some Studies in American Cladonias.'

L. H. PAMMEL: 'Some Notes on the Flora of the Bitter Root Mountains of Montana.'

JAMES E. GOW: 'An Ecological Study of the Sabine and Neches Valleys, Texas.'

W. S. HENDRIXSON: (*a*) 'Action of Bromic Acid on Metal,' (*b*) 'Determination of Bromic and Iodic Acids.'

R. E. BUCHANAN: 'A Study of a Thermophilic Bacterium.'

L. BEGEMAN: 'J. J. Thomson's Theory of Matter.'

H. S. FAWCETT: 'Variation in the Ray Flowers of *Anthemis Cotula* and Other Composites.'

T. H. MACBRIDE: 'Some Slime Moulds of New Mexico.'

B. H. BAILEY: 'Report on Some Iowa Birds.'

NICHOLAS KNIGHT: 'Different Methods of Determining Carbon Dioxide in Minerals and Rocks.'

MORTON E. PECK: 'Flora of Hardin County.'

C. F. LORENZ: 'Three-Color Projection.'

BRUCE FINK: 'Notes on Some Iowa Algæ.'

GRACE ROOD RUEDA: 'The Biology of *Bacillus Violaceus Laurentius*.'

J. P. Anderson: 'Plants New to the Flora of Decatur County, with Summary.'

R. B. Wylie: 'The Morphology of Vallisneria Spiralis' (illustrated).

J. L. Tilton: 'A Problem in Municipal Water-Works for a Small Town.'

T. J. Fitzpatrick: 'The Liliaceæ of Iowa.'

J. M. Lindly: 'The Flowering Plants of Henry County.'

J. L. Tilton: 'The Storage Battery and Switchboard at Simpson College.'

Fred J. Seaver: 'An Annotated List of Iowa Discomycetes.'

Charles R. Keyes: 'Northward Extension of the Lake Valley Limestone.'

Charles R. Keyes: 'Geological Structure of the Jornada Del Muerto and Adjoining Bolson Plains.'

Charles R. Keyes: 'Bisection of Mountain Blocks in the Great Basin Region.'

A. C. Page: 'A Laboratory Barometer.'

Edwin Morrison: 'Cohesion of Liquids and Molecular Weights.'

C. O. Bates: 'Municipal Hygiene.'

L. H. Pammel and Estelle D. Fogel: 'Some Bacteriological Analyses of Railroad Water Supplies.'

The following officers were elected for the ensuing year:

President—M. F. Arey, Cedar Falls.

First Vice President—J. L. Tilton, Indianola.

Second Vice President—C. O. Bates, Cedar Rapids.

Secretary—T. E. Savage, Des Moines.

Treasurer—H. E. Summers, Ames.

T. E. Savage,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

The regular meeting of the academy was held in Syracuse, on the evening of April 15. Professor W. M. Davis, of Harvard University, gave an illustrated lecture on the Colorado Canyon, based upon four visits to the Arizona plateaus. He emphasized the origin of the canyon as a valley of normal erosion exceptional only in depth, as shown fifty years ago by Newberry; its independence of the great fractures of the region whose course is usually north and south, as shown thirty years ago by Powell and Dutton, while the canyon is cut from east to west; and the record of a long geological history magnificently displayed in the canyon walls. This history of the region was traced backwards, first stripping off the horizontal layers of the plateau series, next reconstructing, untilting and stripping off the now inclined layers of the so-called Algonkian 'wedge' and then roughly building the lost mountains of the crystalline foundation rocks, commonly regarded as Archean but not yet demonstrated to be of so great antiquity. Having thus traveled backwards through the 'corridors of time' to the earliest stage of geological history there recorded, the return journey was made along the normal succession of events. Six long ages of time, occupied alternately by deposition and by erosion, were thus reviewed: Three ages of enormous deposition, requiring a correspondingly enormous erosion elsewhere, and three alternate ages of enormous erosion, suggesting an equally enormous deposition elsewhere. The short chapter of canyon erosion was entered upon only after the long earlier ages were closed: thus a correction was suggested for the erroneous view that the erosion of a great canyon requires a long part of geological time. The apex of the Algonkian wedge and the associated ancient plains or peneplains of erosion, best seen from Grand View, sixteen miles east of the railroad terminus, were indicated as the points on which the attention of the inquiring visitor should be focussed. The volcanic history of the district, as associated with the erosion of the canyon, was briefly touched upon.

J. E. Kirkwood,
Corresponding Secretary.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A meeting was held on February 27, in conjunction with the Ethnological Society. General Wilson occupied the chair. The following papers were presented: 'Anthropometry of the Jews of New York,' Maurice Fishberg. Whether the Jews have maintained their racial purity to the present day is a question that can be examined by comparing the physical type of Jew from different countries. Extensive measurements of Jewish immigrants in New York from various countries of eastern Europe show that the Jewish type in those countries is not Semitic, but varies in the different countries, always approximating, in stature and cephalic index, to the native or Christian population of the respective countries.

'Anthropometric Work at the St. Louis Exposition,' R. S. Woodworth and F. G. Bruner. As many as possible of the racial groups represented at the exposition were measured. The best material was found among the Philippine Islanders, of whom about 700 were measured. The Christianized tribes, such as the Tagalog, Pampango, Ilocano, Bicol, Visaya, were found very uniform in physical type. Measurements showed no clear evidence of differentiation among them. The average height of the several tribes differed but little from 161 cm., the cephalic index differs little from 83, etc. The Moros of Mindanao also are practically identical in physical type with the Christian tribes. The pagan Igorots and Bagobos seem to differ considerably from this type, especially in height, which is about 155 cm.; while the Negritos were clearly marked off from all the rest by their kinky hair, small stature (144 cm.), broad nose, and small head in proportion to stature.

R. S. WOODWORTH,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 600th regular meeting, held April 15, 1905, was celebrated by historical addresses in University Hall of the George Washington University, followed by a social hour with refreshments.

After a brief address by President Littlehales, half a dozen papers were read giving a review of the activities of the society since its foundation in 1871, under the presidency of Joseph Henry, in the lines of most interest to its present membership. Mr. Gore grouped and characterized succinctly the papers presented in mathematics. Mr. Wead reviewed the papers on physics, beginning with Henry's 'Aberrations of Fog Signals' and including recent notable work on aerodynamics. Mr. Clarke told of the great local development of activity in chemistry since 1871. Mr. Gilbert spoke of the opportunities the society had furnished to discuss questions in geology, instancing cases where the discussions had led to important researches. Mr. Hayford recalled some of the notable advances in geodesy that had been presented to the society, Mr. Eichelberger reported on the papers in astronomy and Mr. Bauer spoke of the activity in electricity and magnetism. A brief letter from Dr. Gill was read regarding the interest in biology before the formation of the other scientific societies.

THE 601st meeting was held April 29, 1905.

Professor W. S. Eichelberger exhibited one of the Riefler self-winding astronomical clocks belonging to the Naval Observatory and described its construction. It is in a case from which about one eighth of the air is exhausted; the pendulum is of nickel-steel alloy compensated; the power comes from two small cells of battery and is applied about twice a minute. The rate is very small and very constant.

Professor F. H. Bigelow then spoke on 'Ionization and Temperature-Effects in the Atmosphere.' The great problems in meteorology relate to the vertical distribution and semidiurnal curve of temperatures; and to the variations in vapor tension, atmospheric electricity and magnetic field. A great number of curves representing the results of observations on the quantities involved in these problems were exhibited, and the attempt was made to explain the facts according to the modern theory of ionization. The paper will appear in the *Monthly Weather Review.*

CHARLES K. WEAD,
Secretary.

THE SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

THE Science Club held its regular monthly meeting on Friday, April 7, 1905, at 7:30 P.M.

The following papers were presented:

MR. G. G. BECKNELL: 'An Investigation of the Residual Current of the Electric Arc.'

MR. GORDON FULCHER: 'The Duddell Oscillograph.'

Professor O. H. Basquin: 'The Bending Moment of a Uniformly Loaded Beam; a New Experimental Demonstration.'

Floyd Field,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONNECTION BY PRECISE LEVELING BETWEEN THE ATLANTIC AND PACIFIC OCEANS.

To the Editor of Science: In your issue of April 28, 1905, page 673, is an article by Mr. Hayford on 'Connection by Precise Leveling between the Atlantic and Pacific Oceans.' About twenty years ago I wrote to Science in connection with precise leveling over the Alleghanies and the Rocky Mountains, and stated that it might be well to have a systematic determination of bench marks at stated intervals owing to the unrest in the earth's crust. At that time I stated that my work on the corps of the Pennsylvania Railroad had shown me that, however carefully the bench marks might be established at any one time, at the expiration of a comparatively few years there would be a discrepancy between them and the datum plane. The Pennsylvania Railroad has reviewed its bench marks a number of times owing to these discrepancies due to earth motion. The want of agreement, therefore, between the levels of the Atlantic and Pacific Oceans, unless the bench marks were established by surveys which began and ended at exactly the same period throughout the entire distance, might be due to earth movements between the times of the beginning and the end of the survey.

I would again suggest, as I did at my first letter to this paper, that the United States Geological Survey secure not only the lists of bench marks of all railroads, but the variations that have occurred in these bench marks as shown by repeated surveys. If these are carefully tabulated throughout a century, we may obtain important information in regard to the upward and downward crustal movements across the continent.

Edward H. Williams, Jr.

SPECIAL ARTICLES.

THE HORIZONTAL PLANE OF THE SKULL AND THE GENERAL PROBLEM OF THE COMPARISON OF VARIABLE FORMS.

In comparative studies of the skull it is customary to select one transversal plane defined by the axis of symmetry with which it is at right angles and by two points, as the standard plane to which the skull is referred. Some authors have made the selection of the two determining points based on morphological considerations, while others have endeavored to determine the physiological horizontal position, determining the latter by two points which are more or less accurately parallel to the direction of horizontal sight.

When this problem is considered from a purely morphological point of view, it will be recognized that there is no justification in selecting arbitrarily two points and disregarding all others, but that the best method of comparison must be based on the assumption that every point of the skull has equal weight and that the nearest approach of all points must be attempted. In this form the problem is applicable to the comparison of all variable forms.

The most favorable superposition of any two forms will be obtained when the sum of the squares of the distances between all pairs of homologous points becomes a minimum. We will refer the body to a system of rectangular coordinates and call x', y' *and* z' the ordinates of a point of the first body, x'', y'' and z'' the ordinates of the homologous point of the second body. By moving the second body by the amounts u, v and w in the direction of the three ordinates, we can modify the relative positions of homologous points without torsion of the body. Then the sum of the squares of the distances of homologous points

$$\Sigma(x'-x''-u)^2+\Sigma(y'-y''-v)^2+\Sigma(z'-z''-w)^2$$

is to be a minimum. Therefore,

$$\Sigma(x'-x''-u)=0.$$

And

$$u=\Sigma(x'-x''),$$

$$v=\Sigma(y'-y''),$$

$$w=\Sigma(z'-z'').$$

Since we may assume the origin of the first system of ordinates arbitrarily, we may take

$$\Sigma x' = \Sigma y' = \Sigma z' = 0 ;$$

in other words, we take the geometrical center of gravity of the first body as the origin of our system of ordinates. Then

$$\Sigma x'' = \Sigma y'' = \Sigma z'' = 0 ;$$

i. e., the two bodies must be so placed that their geometrical centers of gravity coincide.

Provided the two forms are symmetrical, this result gives a complete solution of the problem. If the forms are irregular, the degree of torsion must be determined which will give the best result. In most cases the form in question will be symmetrical in at least one direction, so that torsion in one direction only need be considered. Starting with the geometrical center of gravity as the origin of a system of polar coordinates, we have for any given pair of points the coordinates l' and l'' as distances from the center, and a' and a'' as angles with the zero line. If we give the second system of points the torsion ξ, we find that

$$\Sigma \{ l'^2 + l''^2 - 2l'l'' \cos (\xi + a'' - a') \}$$

must be a minimum; or

$$\Sigma l'l'' \sin (\xi + a'' - a') = 0,$$

$$tg\xi = - \frac{\Sigma l'l'' \sin (a'' - a')}{\Sigma l'l'' \cos (a'' - a')}.$$

Theoretically, the problem can, therefore, be solved. By using a limited number of well-selected points a good superposition of the two forms can be made.

Experiments, so far as carried out, indicate that alveolar point, nasion, bregma, lambda, basion and pterion give a good superposition of skulls.

It will be noticed that if this method is pursued the arbitrary element in composite drawings or photographs may be eliminated.

FRANZ BOAS.

XUALA AND GUAXULE.

THE location of two Indian villages, Xuala and Guaxule, mentioned in some form by all of the chronicles of Hernando de Soto's wild and unfortunate expedition (1539–41) through the territory now included in the southern states, are important in determining the route of this Spanish adventurer. If the location of these two villages—especially the first—can be determined with reasonable certainty it will enable us to fix the route of the Adelantado with comparative accuracy from his landing place at Tampa Bay, Florida, until he reached the vicinity of Mauvilla in Alabama.

The widest variation in opinion of the numerous authorities touching upon the subject, relates to the position of Xuala; these views, however, may be classed in two unequal groups, as is evident from the following list: The map of Cornelius Wytfliet in his 'Descrip. Ptolemaica (1596)' locates this village on the west side of Savannah River near the head. DeLisle's map (1707?) in French's 'Hist. Coll. La.,' though indefinite, places it west of the Savannah. Later authorities locate it as follows: Pickett ('Hist. Alabama,' I., p. 8); C. C. Jones, Jr. ('Hernando de Soto,' p. 13); Cyrus Thomas (5th 'Ann. Rep. Bur. Eth., p. 95); and Theodora Irving ('Hist. Cong. Florida,' II., p. 8), all locate it west of the upper Savannah in Nacooche valley, Habersham County, Georgia, or in that immediate vicinity. Mr. James Mooney (19th 'Ann. Rep. Bur. Eth.,' pt. 1, p. 195) and Woodbury Lowery ('Spanish Settlements within the United States,' p. 230, in the text, but not on the map) locate it in the 'piedmont' region of North Carolina, about the head of Broad river—which would be about Henderson County. Gilmore Shea in his article entitled 'Ancient Florida,' in Justin Winsor's 'Narrative and Critical History of America, II.,' follows, in this part of De Soto's route, the course given by C. C. Jones, Jr. Buckingham Smith on the map in his 'Narrative of De Soto' (Bradford Club Series, V., pl. 5) places Xuala about Habersham County, Georgia, but locates Guaxule to the northwest, apparently about Towns County of the same state, or possibly over the line, in Tennessee. Although Shipp ('De Soto and Florida') does not locate Xuala, he places Guaxule in Bartow County, Georgia, thus agreeing substantially with Pickett, Jones and

Thomas. The 'New International Encyclopedia' follows, in part, Mooney and Lowery, but also differs from them in part.

It will be seen from this list that the general consensus of authorities—all, in fact, but two or three—locate Xuala somewhere in northern Georgia, most of them in Habersham County, while Mooney and Lowery place it in southwestern North Carolina, somewhere in the region of Henderson or Rutherford County. Although the article 'De Soto,' in the 'New International Encyclopedia' apparently follows Mooney in locating Xuala, though it does not mention the name, it differs radically from them in regard to the immediately following portion of the route, carrying it down the Coosa, instead of the Chattahoochee. It is rather strange that Lowery on the 'Sketch Map' of his work locates Xuala in or near Habersham County, northeastern Georgia, and Guaxule about Bartow County, and follows down the Coosa River instead of the Chattahoochee as in his text (p. 230).

The object at present is to examine briefly the data and determine, if possible, which of these two divergent views agrees most nearly with the original chronicles of the expedition, and the topography of the country, or whether both are erroneous.

All the facts bearing upon this particular inquiry to be drawn from the original chronicles relate to the march from Cofitachiqui—where the Adelantado was so royally entertained by the noted cacica—to Chiaha, where he paused to recuperate because of abundant food and pasture.

It is now generally conceded that Cofitachiqui was located on the east bank of Savannah River, at or near Silver Bluff, about twenty-five miles below Augusta, though one or two authors have contended that it was at the junction of Broad and Savannah Rivers. We shall, therefore, proceed upon the assumption that it was at or in the vicinity of Silver Bluff—as this theory is maintained by the views we propose to discuss; calling attention first to that theory which places Xuala in western North Carolina.

From Cofitachiqui, according to all the original chronicles, De Soto and his army proceeded northward, without, so far as the records show, recrossing the river, hence on the east side of the Savannah, in what is now South Carolina. However, in order to procure a supply of food the army was divided into two parties, that with De Soto going directly onward, while the other turned aside, some twelve leagues, say the chronicles (probably toward the bottom land), where there was a store of maize offered them by the cacica.

Before reaching Xuala they passed through some small villages or settlements of the Chalaque (or Achalaque) now recognized as the Cherokees. The time given for the march from Cofitachiqui to the Chalaque by the different chroniclers differs considerably; Elvas states it was seven days; Garcilasso, eight; and Ranjel (in Oviedo), only two. Biedma does not mention Chalaque, but makes the time occupied in going from Cofitachiqui to Xuala eight days. As further data regarding the time occupied, it may be stated that Elvas makes the time from Cofitachiqui to Xuala twelve days. Ranjel makes it seven days, mentioning as an intermediate village Guaquili—not noted by the others—which he says was three days' march from Xuala. Garcilasso makes the distance between the same points fifty leagues. All agree in giving the time from Xuala to Guaxule as five days.

As the particular view we are now discussing is that maintained by Mr. Mooney and Mr. Lowery (in his text) and the latter follows the former without going into details, for these we have necessarily to refer to the statements by the former.

According to these the Chalaque villages were probably on or near Keowee River, for which point we may assume Anderson, Anderson County, South Carolina, as among the modern names along the supposed route. From this point the Adelantado's force proceeded to Xuala, which this authority, as already stated, places about Henderson County, North Carolina. From there, according to both authorities, they moved west, 'down French Broad' River as far, we are justified in supposing (as no point is mentioned), as to or near the site of Asheville. From there these authors carry them southwest to

White County, Georgia, where they arrive at Guaxule. This route, if traveled by De Soto as this theory supposes, was according to the geologist of the U. S. Geological Survey, who has been at work in that section, most likely, as follows: Using modern names to designate the points; from Anderson, South Carolina, to Greenville, same state, 26 miles; thence across Blue Ridge to Hendersonville, North Carolina, 35 miles; thence down French Broad valley to Asheville, 22 miles; thence through Hominy Gap and up Richland Creek to Waynesville, 30 miles; thence through Balsam Gap and down Scott's Creek to Webster, 24 miles; thence across Tuckasugee River and Cowee Mountains to Franklin, 17 miles; thence across Nantahala River and down Shooting Creek to Hiwassee, 32 miles; thence up Hiwassee River and down the Chattahoochee to Nacoochee, White County, Georgia, 25 miles, part of this line being along an old Indian trail. As the distance from Silver Bluff to Anderson is about one hundred miles, two or three more or less, this makes the entire distance along this supposed route from Cofitachiqui to Guaxule three hundred and eleven miles, and from Cofitachiqui to Xuala, one hundred and sixty-one miles, and from Xuala to Guaxule one hundred and fifty miles.

Though the route actually traveled according to this theory may not have been precisely that laid down, it must have been near to and parallel with it, and the distance and character of the country were substantially the same.

Our reasons for rejecting this theory are as follows: First, the distance, at least between some of the points, is too great to have been traveled by the army with its incumbrances, among which was a drove of hogs, in the time specified. These hogs may by constantly moving have become good travelers, and may have accomplished the trip from Cofitachiqui to Xuala, a distance of about one hundred and sixty miles, in twelve days—the longest time given by any of the chroniclers. But when the distance from Xuala to Guaxule, which on this route was at least one hundred and fifty miles, has to be traveled in five days, the time given by all the chronicles—a rate of thirty miles per day—the requirement becomes an utter impossibility for an army thus hampered, and scarcely possible for an army free from these incumbrances, especially through a rough and densely wooded country where there were no other roads than narrow pathways.

This route places Xuala on the west or north of the Blue Ridge which has to be crossed in going from Greenville to Hendersonville.

Another insuperable objection to this route is that it requires us to assume that the territory of the cacica extended into western North Carolina, or included a detached section therein with the Sara or Cheraw, a Siouan tribe, as subjects, hedged in between the Cherokees and the Catawbas. This would be extraordinary.

This assumption is absolutely necessary, if we follow the theory in question, as it is clear, from all the chronicles, that Xuala was under the cacica's control. It is even stated by one chronicler that after she made her escape, which occurred between Xuala and Guaxule, it was ascertained that she was at the former village where she and the negro Robles, who escaped at the same time, were living as husband and wife. The assumption of this route requires not only the supposition that the Cheraws were her subjects and their country in her kingdom, but also when she escaped she went back northward into western North Carolina instead of continuing southward to her own proper capital. It also necessitates the supposition that her flight was mostly through Cherokee country, where she would more likely have been taken captive and possibly slain than kindly concealed and helped on her way.

Another reason for rejecting this theory is that it places Guaxule in White County, Georgia, where no mound of the character described is known to exist or to have existed. It is claimed by advocates of the theory that there is a mound which will answer the description near Clarksville. This, however, is a mistake. There is, it is true, a mound in that locality, but it will by no means fill the requirements. It is in the upper part of Nacoochee valley, near its western extremity, and it is only about, or a little over, twenty feet high, elliptical in form and flat on top. Its base diameters are 190 and 150 feet and its top diameters 90 and 60 feet. There are no evidences of terraces or a graded way; the sides slope gradually from the summit. It has been plowed over for many years, but this would not have effaced entirely a terrace or graded way had there been one. Moreover, there were no such indications extant half a century ago. There is, however, a mound in Bartow County, Georgia, which does fully meet the requirements of the chroniclers' descriptions.

Another reason for rejecting this route is that it follows down the Chattahoochee River instead of the Coosa; in other words, eliminates the 'Coza' for which the Adelantado was in search, and which his successors endeavored to reach. Hamlet is taken out of the play unless the name 'Coza' is transferred to Chattahoochee.

Another reason for considering this theory erroneous is that although the army must have passed through Cherokee territory after leaving Xuala, if this route was followed, no mention whatever of this fact is made by any of the chronicles.

Finally the theory is erroneous because it is based on a mistake. It is apparent, from the statement of the author we have been referring to, that the conclusion reached by others, that Xuala was in northeastern Georgia, was set aside because he had ascertained, as he believed, that there was formerly a tribe of Indians named Suali or Suala in western North Carolina; hence as Xuala might be pronounced Shuala, the two must be one and the same people, in fact he says (Nineteenth Annual Rep. Bureau of Eth., Pt. 195): "As the province of Chalaque is the country of the Cherokee, so the province of Xuala is the country of the Suali or Sara Indians, better known as the Cheraws."

On this slender foundation of a slight resemblance in names does the theory appear to be built, which takes De Soto and his army, with their hogs and other incumbrances, into the 'piedmont region of North Carolina.'

The objection, however, does not stop here, for the statement that there was an Indian tribe in southwestern North Carolina known as Suali or Suala appears to be based solely on the name as used by John Lederer in his 'Discoveries in Three Several Marches' (1672). But it has been shown (*American Anthropologist,* N. S., Vol. 5, No. 4, 1903) that his reputed expedition into Carolina is clearly a fiction, that he was never nearer this point than along the southern border of Virginia, his statements in regard to this section are, therefore, unreliable. What few facts he mentions being obtained, in all probability, from the Indians along Roanoke River, and from the accounts of other earlier explorers, with which he seems to have been familiar.

His name Suali or Suala seems to refer to De Soto's Xuala, of which he appears to have obtained knowledge; in fact, he states that it was obtained from the Spanish. As he knew it was somewhere in the direction of his imaginary journey without any knowledge as to distance, he uses the name to give weight to his fictitious narrative. Distance would have troubled a writer but little who definitely placed a great lake in western North Carolina and believed that the Pacific laved the western slope of the Alleghanies.

Unfortunately, however, for the theory, Lederer nowhere applies the name to the Indians, but throughout expressly limits it to mountains, giving the name Sara to the Indians. The theory, therefore, as given is absolutely without a foundation stone, as the name Suali or Suala was never applied to Indians so far as we are able to ascertain until Mr. Mooney so used it in his 'Siouan Tribes of the East.'

Believing the foregoing reasons to be entirely sufficient for rejecting the theory that Xuala was in the 'piedmont region of North Carolina,' we next proceed to give our reasons for believing that this village or province was located in northeastern Georgia, and Guaxule in northwestern Georgia, most likely in Bartow County.

In attempting to trace that portion of De Soto's route now under discussion it is best to accept what seems to be the most satisfactory evidence in regard to one particular locality mentioned. One item is given by Garcilasso in respect to Guaxule that appears to fix this town, beyond any reasonable doubt, at the mound group near Cartersville, Bartow County, Georgia. The statement of this author is as follows: "La casa estava en un cerro alto, como de otras semejantes hemas dicho. Tenio toda ella el derredor un paseadero que podian pasearse por el seis hombres juntos." "The house [of the chief] stood on a high hill [mound] similar to others we have already mentioned. It had round about it a roadway on which six men might march abreast."

The 'similar to others we have already mentioned' is evidently intended to signify it was artificial, and this is admitted by all who allude to it. The statement that it was 'high' signifies more, in the eyes of the Spaniards, than an ordinary elevation. The large mound of the Etowah group near Cartersville, Bartow County, Georgia, is 66 feet high with base diameters of 380 and 330 feet, and top diameters about 160 and 180 feet. Running up the south side is a broad roadway varying in width from 37 to 56 feet. In bulk it is next in size to the great Cahokia mound near St. Louis. Here then we have a mound which will completely satisfy the description, and the only one in all that section of the south—as is now positively known—which will do so. Moreover, it is sufficiently near Canasauga River to agree with the narrative. There is no reason, therefore, except to maintain a theory, why this should not be accepted as the site of Guaxule. Assuming this as one fixed point, the possibilities of the position of Xuala become much more limited than without this determination.

As the suggestion above mentioned, that the Chalaque villages were near the Keowee River, may be accepted as probably correct, it is apparent from the limited time of the march from Xuala to Guaxule—five days—that we must place the former town somewhere in northeastern Georgia, probably in White or Hall County or in that section. A statement by Biedma appears to have a decided bearing on this question; it is as follows:

Again we took the direction of the north, and for eight days we traveled through a poor country, scarce of food, until arriving at one called Xuala, where we still found some Indian houses, though a sparse population, for the country was broken. Among these ridges we discovered the source of the great river by which way we started, and which we believed to be the Espiritu Santo. We went on to a town called Guasuli, where the inhabitants gave us a number of dogs, and some maize, of which they had but little; whence we traveled four days and we arrived at a pueblo which was called Chiha, which possessed more food; this is situated on an island of this river of the Espiritu Santo, which from its source has large ones (islands).

That they struck the headwaters of Coosa River, which they thought was the Espiritu Santo (Mississippi), and that they followed it down to Chiaha seems evident, for the description of this river by Biedma in the foregoing citations fits no other river in this region than the Coosa.

This supposition is apparently confirmed by the earliest known map of De Soto's route, made before Tristan de Luna started on his expedition, given by Harrisse in his 'Discovery of North America.' In this a river is laid down about the same locality as the Coosa (and Etowah) running westward marked with islands and towns. It is continued westward, however, to the Mississippi and was evidently drawn to correspond with Biedma's statement, regardless of the fact that De Soto and his followers must have learned at length that it did not extend to the Mississippi. This fact, however, was overlooked by the mapmaker.

CYRUS THOMAS,
J. N. B. HEWITT.

BOTANICAL NOTES.

THE STUDY OF PLANT MORPHOLOGY.

NEARLY twenty years ago Professors Arthur, Barnes and Coulter published a useful book on the morphology of plants under the title of 'Handbook of Plant Dissection.' It included suggestions for studies of a dozen representative plants selected from all parts of the vegetable kingdom. These authors finding themselves unable to undertake the rewriting of the book for a new edition delegated the task to a younger man, Professor O. W. Caldwell, who brings it out under the new title 'Handbook of Plant Morphology'

(Holt & Co.). The new book follows the old one in plan, and to a considerable extent in detail also. By abridgment of the suggestions to the student (an improvement over the old book) the author has been able to take up more than twice as many plants, thus enabling the teacher to make a better selection where it is not possible to study all of them. Two things are emphasized in the book, namely, that structures of plants are related and more or less perfectly adapted to the two primary functions of nutrition and reproduction, and that there has been a gradual evolution of plants in the vegetable kingdom. The purpose of this course in plant morphology is to give the pupil broader views of plants and their structure, and in this the author has succeeded very well. The book should find place in the better class of high schools.

There is only one serious criticism to be made on the book, and that is that in the glossary the suggestions as to the original meanings of the terms (given in parentheses) are often very misleading. In another edition these suggestions should be wholly omitted, or the roots from which the terms are derived should be inserted, as was done in the old book.

PLANTS OF THE BAHAMA ISLANDS.

The vegetation of the Bahama Islands is lucidly sketched and discussed by Professor Doctor W. C. Coker in a recent paper published by the Geographical Society of Baltimore. A short history of the botanical explorations of the islands is given, followed by discussions of the composition and relationships and distribution of the Bahama flora. Annotated lists are given of the plants of economic importance, including trees and shrubs useful for their woods or leaves (20 species); medicinal plants (6 species); indigenous fruits (10 species); cultivated fruits (25 species); ornamental trees (10 species). Twenty-five to thirty pages are given to an ecological discussion of the vegetation on the different islands, followed by a systematic list of all the species collected, beginning with slime molds (11 species), and including algae (50 species), fungi (22 species), lichens (40 species), mosses and liverworts (16 species), ferns (14 species) and flowering plants (423 species)—in all 580 species. Sixteen full-page plates, including half-tone reproductions of thirty-one fine photographs, complete this instructive paper.

RECENT BOTANICAL PAPERS.

Professor Doctor Arthur finds (Bull. 103, Indiana Expt. Station) that smut may be destroyed in seed oats by the simple operation of sprinkling the seed with a solution of formalin of a strength of one pound of the formalin to fifty gallons of water, using enough water to make the oats moist enough 'to pack in the hand.' It is then to be shoveled into a pile and covered for two hours, when it is ready for sowing. If preferred it may be spread out and dried before sowing.—C. L. Shear discusses the fungous diseases of the cranberry (Farmers' Bull. 221, U. S. Dept. Agr.), namely, 'blast,' 'scald,' 'rot' and 'anthracnose.' It is shown that these diseases may be controlled by a proper application of Bordeaux mixture.—'The Shade Trees of Denver' (Bull. 96, Colorado Expt. Station), by Professors Paddock and Longyear, possesses more than local interest in that it records all the trees not natives of Colorado which are known to be growing in Denver. When it is remembered that the elevation of the city above sea level is exactly one mile, it is evident that the conditions are very different from those where these exotic trees originated. The growing of trees under such conditions becomes an interesting experiment in the acclimatization of plants.—The latest 'Contribution' from the Gray Herbarium of Harvard University (No. XXIX.) includes descriptions of new species of plants from the islands of Margarita and Coche, Venezuela, by Dr. B. L. Robinson. The announcement is made that Dr. Robinson has in preparation a flora of the islands.—The second part of Professor Gifford Pinchot's 'Primer of Forestry' has recently appeared as Part II. of Bull. 24 of the United States Bureau of Forestry. This part deals with the practise of forestry, with work in the woods, and with the relation of the forest to the weather and the streams, and concludes with a short account of forestry at home and abroad. It is beautifully illustrated with half-tone reproductions of photographs. It will be very helpful to forestry students.

Charles E. Bessey.

The University of Nebraska.

THE HARVEY SOCIETY OF NEW YORK CITY.

A new society called the Harvey Society, consisting of laboratory workers in New York City, has recently been established under the patronage of the New York Academy of Medicine. Its purpose is the diffusion of scientific knowledge in selected chapters of anatomy, physiology, bacteriology, pathology, pharmacology and physiological and pathological chemistry, by means of public lecures by men who are workers in the subjects presented.

Each lecture is intended to represent the state of modern knowledge concerning the topic treated and at the same time will be adapted for presentation before an audience consisting of that portion of the general medical profession who are interested in the scientific side of medicine.

It is hoped that through these lectures the common interests of research workers and the medical profession may be profitably cultivated. The fulfilment of the purposes of the society has been entrusted to the hands of the following committee:

Graham Lusk, *president*,
Simon Flexner, *vice-president*,
George B. Wallace, *secretary*,
Frederic S. Lee, *treasurer*,
Christian A. Herter,
S. J. Meltzer,
E. K. Dunham.

The members of the society consist of two classes, active and associate members. Active members are laboratory workers in the medical sciences residing in New York. Associate members are such persons as may be in sympathy with the objects of the society and reside in New York.

The first course of lectures will be given on Saturday evenings during the winter of the years 1905–1906 at the Academy of Medicine.

SCIENTIFIC NOTES AND NEWS.

The Royal Society elected, on May 11, the following new fellows: John George Adami, professor of pathology, Montreal; William Arthur Bone, lecturer on chemistry, Manchester; John Edward Campbell, mathematical lecturer, Oxford; William Henry Dines, meteorologist, London; Captain Arthur Mostyn Field, R.N., hydrographer of the Navy, London; Martin Onslow Forster, assistant professor of chemistry, Royal College of Science, London; Edwin S. Goodrich, demonstrator of anatomy, Oxford; Frederick Gowland Hopkins, reader in chemical physiology, Cambridge; George William Lamplugh, district geologist on the Geological Survey, Ireland; Ernest William MacBride, professor of zoology, Montreal; Francis Wall Oliver, professor of botany, University College, London; Lieutenant-Colonel David Prain, I.M.S., superintendent of Royal Botanic Gardens, Calcutta; George F. C. Searle, senior demonstrator in Cavendish Laboratory, Cambridge; Hon. Robert John Strutt, fellow of Trinity College, Cambridge; Edmund Taylor Whittaker, mathematical lecturer of Trinity College, Cambridge.

Dr. Franz Boas has resigned from the curatorship of the anthropological department of the American Museum of Natural History. He will continue his connection with the museum, conducting the researches and publications of the Jesup North Pacific Expedition and of the East Asiatic Committee.

Dr. Allan McLaughlin has been appointed head surgeon of the Marine Hospital at Naples, in the service of the United States.

Professor James H. Tufts, of the University of Chicago, was elected president of the Western Philosophical Association at the meeting held at the University of Nebraska on April 21 and 22.

Sir Willaim de W. Abney, K.C.B., Mr. Shelford Bidwell, Lord Alverstone, Dr. Ludwig Mond, Lord Rosse, Sir Thomas H. Sanderson, Sir James Crichton-Browne (treasurer), and Sir William Crookes (hon. secretary), have been nominated as vice-presidents of the Royal Institution, London.

The Jacksonian prize of the Royal College of Surgeons of England has been presented to Mr. Herbert J. Paterson.

The Hanbury gold medal of the Pharmaceutical Society, London, has this year been awarded to Professor Ernst Schmidt, professor of pharmaceutical chemistry in the University of Marburg.

Dr. William Welch, professor of pathology at the Johns Hopkins University, sailed for England on May 27, to be absent until September.

Dr. Ernest W. Brown, professor of mathematics, Haverford College, will be a member of the official party of the British Association for the South African meeting. He will be absent from Haverford from June 15 to October 30.

Mr. A. Pitts Morse, of the zoological department of Wellesley College, will this summer continue his researches on the North American Acridiidae. He will make a collecting tour through Alabama, Mississippi and Louisiana.

Robert Kennedy Duncan, professor of chemistry in Washington and Jefferson College, has been granted a year's leave of absence in order to accept a commission from *Harper's Magazine* to spend a year in Europe in the study of the relations of chemistry to industry. Dr. Ralph Garrigue Wright will act as substitute during his absence.

Professor Hecker, who has been making observations for gravity in the Indian and Pacific oceans and at various coast stations, under the auspices of the International Geodetic Association, returned to Berlin about the middle of April. It is reported that satisfactory observations were obtained by him.

The degree of doctor of science in botany has been conferred by the University of London on Miss Agnes Robertson for a thesis entitled 'Studies in the Morphology of *Torreya Californica,* Torrey,' and other papers.

At a meeting of the Royal Geographical Society held on May 16 a paper, entitled 'Exploration and Survey with the Tibet Frontier Commission, and from Gyangtse to Simla *via* Gar-tok,' was read by Major C. H. D. Ryder, R.E. Major Ryder was the officer in charge of the survey work carried out in connection with the British Mission to Lhasa, and for his services to geographical science has this year been awarded one of the society's highest honors, the patron's gold medal.

A portrait of Dr. Thomas Young has been presented to the Royal Institution, London, by Mrs. Barton.

Sir Bernhard Samuelson, F.R.S., an iron manufacturer who was interested in technical education, died on May 10, in his eighty-fifth year.

Lieutenant-Colonel L. H. L. Irby, a British ornithologist, has died at the age of sixty-nine years.

There will be a civil service examination, on June 21, for the position of assistant in the Office of Seed and Plant Introduction, Department of Agriculture, at a salary of $1,800.

Governor Higgins has signed the bill incorporating the Staten Island Association of Arts and Sciences, which thus becomes the successor to the Natural Science Association of Staten Island. The act authorizes the city to provide accommodation for the association in the new borough hall temporarily, to erect suitable buildings for a public library and museum and to contribute $10,000 annually for maintenance.

The California legislature has made an appropriation providing for the establishment of a laboratory and experimental station for the study of plant diseases in Southern California, the station to be conducted under the auspices of the Department of Agriculture of the University of California.

Arrangements are now almost complete for the opening of a marine biological station at La Jolla, a suburb of San Diego, Cal., under the direction of Professor William E. Ritter, of the University of California. The laboratory will take the place of the one that has been conducted by Professor Ritter during the past year or two at Coronado Beach.

The Biological Laboratory of the Bureau of Fisheries at Woods Hole, Mass., will open for the current season on or about June 15. Opportunities for research in the field of marine biology will, as usual, be furnished to a limited number of qualified investigators. Candidates for tables should send applications at an early date to the commissioner of fisheries, Washington, D. C., or to the director of the laboratory, Dr. F. B. Sumner, College of the City of New York, New York, N. Y. Applications from those who are not already known at the station should be accompanied by proper endorsements.

The Georgian Bay Biological Station will be open from June 5 to September 5. The station is a summer laboratory, established in 1901 by the Dominion government in connection with the Department of Marine and Fisheries, for the investigation of problems in lacustrine biology. It is located at Go Home Bay, a small offshoot of the Georgian Bay, distant about twenty miles from the towns of Midland and Penetanguishene, and on the course of the Northern Navigation Company's steamboat line connecting Penetanguishene and Parry Sound. There is no charge to those wishing to work in the laboratory.

It is said that Mr. William Ziegler, who died on May 24, has provided in his will for the continuation of his Arctic explorations. It will be remembered that Mr. Anthony Fiala is now in the Arctic regions under Mr. Ziegler's auspices. He has not been heard from for two years, and two relief expeditions have now been sent.

The American Mathematical Society will hold its twelfth summer meeting at Williams College, Williamstown, Mass., on September 7 and 8.

The German Mathematical Society will hold its annual meeting at Meran, Tyrol, from September 24 to 30, under the presidency of Professor P. Stäckel, of the University at Kiel.

In the spring of this year the International Geodetic Association set aside 80,000 Marks for the purpose of extending variation of latitude observations to the southern hemisphere. The plans of the association are making good progress, and it is expected that the astronomers who will carry on the work will reach the points selected in November of this year. One of the observatories will be established near Cordova, Argentine Confederation, and the other near Perth, in Australia.

It was stated in the issue of Science, for April 21, that the New Mexico legislature had appropriated $6,000 for a State Geological Survey to be spent under the direction of the New Mexican School of Mines at Socorro. We are informed that the only reference to such a survey occurs in the general appropriation bill and is as follows: 'For publication U. S. geological survey reports to be expended under the direction of the Socorro School of Mines, or so much thereof as may be necessary, $2,500.'

A Reuter telegram from Berlin says that in the course of excavations in the neighborhood of Breslau 400 graves and 150 prehistoric dwelling places have been brought to light. The oldest of the graves contained bones dating from a period previous to the Bronze Age, and in another grave near by were found urns showing that they had contained bodies interred five centuries later. The excavators have been able to trace the site of a village of the bronze age. About a dozen huts are clearly recognizable. A whole collection of spinning and weaving appliances has also been dug up.

Consul-General Richard Guenther, of Frankfort, reports that the Associazione degli Industriali d' Italia, No. 61 Foro Bonaparte, Milan, Italy, invites inventors to compete for two prizes offered by it, as follows: First prize, $1,600 and a gold medal, for a new method to prevent danger which may arise from the contact of high tension with low tension wrapping at electric rotary-current transformers; second prize, $100 and a gold medal for a simple, strong, and reliable safety device for stopping cars running on an inclined plane in case of the breaking of the wire cable. The device must be capable of adjustment to the ordinary cable roads now in use.

The Adams prize for 1906 is offered for an essay on 'The Inequalities of the Moon's Motion Due to the Direct Action of the Planets.' The prize, which is of the value of £225, is open to the competition of all persons who have at any time been admitted to a degree in the University of Cambridge.

The Bureau of Forestry has published a circular giving information regarding employment on the national forest reserves. This circular explains how appointments to the Forest Service on the reserves are made, states the salaries of its members and indicates the knowledge and experience required of rangers and supervisors and the duties each must perform. The future organization will include forest supervisors at $1,800 to $2,500 a year, deputy forest supervisors at $1,500 to $1,700, forest rangers at $1,200 to $1,400, deputy forest rangers at $1,000 to $1,100 and assistant forest rangers at $800 to $900. The law requires that every applicant for a position in the Forest Service pass a civil service examination. Legal residence in the state or territory in which employment is desired is generally necessary, since only where examinations fail to secure thoroughly satisfactory men are vacancies filled by the examination of applicants from other states. Appointments of supervisors are made, so far as practicable, by promotion of competent rangers or forest assistants. To be eligible as forest ranger the applicant must be physically sound, accustomed to outdoor work, and know how to take care of himself and his horse in regions remote from settlement and supplies. He must know something of surveying, estimating and scaling timber, lumbering and the livestock business. Some of the reserves require a specialist in one or more of these lines of work. The applicant must be thoroughly familiar with the region in which he seeks employment. The entire time of rangers is to be given to the service. Rangers, under the direction of the forest supervisor, patrol to prevent fire and trespass; estimate, survey and mark timber and supervise its cutting; issue mining permits, build cabins and trails, enforce grazing restrictions, investigate claims and make arrests for violation of reserve laws. Forest supervisors must have all the qualifications of rangers, combined with superior business and administrative ability. They deal with the public in all matters connected with the sale of timber, the control of grazing, the issuing of permits and the application of all regulations for the use and occupancy of forest reserves. Knowledge of technical forestry is desirable, but not essential.

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that Harvard University has received an anonymous gift of $100,000 for a museum of social ethics, and $50,000 from Mr. Jacob H. Schiff, of New York, for explorations in Palestine.

The Ontario government has announced a provisional grant of $500,000 to the University of Toronto towards the proposed new buildings which, it is estimated, will cost $1,600,000.

The Drapers' Company has agreed to give £5,000 for a building for the department of agriculture at Cambridge, provided that an equal sum be raised by voluntary contribution.

A. S. Mackenzie, A.B. (Dalhousie), Ph.D. (Johns Hopkins), professor of physics in Bryn Mawr College, has been appointed to the chair of physics in Dalhousie College.

Dr. J. E. Duerden, of the University of Michigan, formerly curator of the museum, Jamaica, has been appointed professor of zoology, at the Rhodes University College, Grahamstown, Cape Colony, South Africa.

Mr. L. R. Waldron, assistant professor in the department of botany and zoology of the North Dakota Agricultural College has lately resigned to accept a position of superintendent of the Sub-Experiment Station located at Dickinson. Mr. W. B. Bell of the University of Iowa has been elected to fill the vacancy.

Austin Flint Rogers, A.B. (Kansas), Ph.D. (Columbia), tutor in mineralogy in Columbia University, has been appointed assistant professor of mineralogy and petrography in Stanford University.

The Board of Trinity College, Dublin, has founded a chair of education, and Mr. Edward P. Culverwell, fellow of Trinity College, has been elected to the professorship.

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FRIDAY, JUNE 9, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*SOME AMERICAN CONTRIBUTIONS TO TECHNICAL CHEMISTRY.**

THE inventive genius of the American people is universally conceded. The necessity of accomplishing things quickly, incidental to the growth of a new country, such as ours, has naturally led to the invention of many forms of labor-saving machinery, and so with improved appliances have come improved methods. The technical chemist is, however, less fortunate than his brother in the professorial chair whose merits are made known by his students, thus attracting an ever-increasing following to his laboratory, and perhaps he is also less fortunate than his associate who devotes himself to research work; for to him are given medals and honorary memberships which are properly the 'blue ribbons' of science; hence it is that the discoveries of the technical chemist, especially where they are commercially meritorious, remain too frequently unknown, and the profits of the improvement go to swell the dividends of the corporation to which he owes his allegiance while he receives no public recognition. It naturally follows, therefore, that any summary of the achievements in the development of technical chemistry must be very incomplete.

To say when chemistry begins is not generally possible, for its origin wanders back into alchemy and pharmacy on the one side and into physics on the other, and there are no sharp lines of separation among the

* An address delivered before the Congress of Arts and Science, St. Louis, September, 1904.

various branches of science, for they gradually merge one into the other. In this country, however, we have grown to accept the date of the arrival of Joseph Priestley, June 4, 1794, as a most excellent time at which to begin the modern history of chemistry.

The younger Silliman's masterly 'American Contributions to Chemistry'* gives me the right, therefore, to mention first Benjamin Thompson, Count Rumford (1751–1814),† whose studies in heat and fuel were as practical as they are important. His early knowledge of science was acquired from John Winthrop (1717–1779), who held the chair of mathematics and natural philosophy at Harvard from 1738 till his death. Of Count Rumford I have said elsewhere:‡ 'He investigated the properties and management of heat, and the amount of it that was produced by the combustion of different kinds of fuel, by means of a calorimeter of his own invention.' By reconstructing the fireplace he so improved the methods of warming apartments and cooking food that a saving of fuel of almost one half was effected. He improved the construction of stoves, cooking ranges, coal grates and chimneys, and showed that the non-conducting power of cloth is due to the air that is enclosed in its fibers. Silliman well says of him: 'No writer of his time has left a nobler record of original power in physical science than Rumford.' It will also be remembered that by will he provided funds 'to teach by regular courses of academical and public lectures, accompanied by proper experiments, the utility of the physical and mathematical sciences for the improvement of the useful arts, and for the extension of the industry, prosperity, happiness and well-being of society.'* Let me also remind you that Wolcott Gibbs, the oldest and now the Nestor of American chemists, held the Rumford chair in the Lawrence Scientific School of Harvard from 1863 till 1888, during which time many of those who are now leaders in chemistry were students under him.

* *American Chemist*, V., 1874, p. 70.

† See 'Memoir of Sir Benjamin Thompson, Count Rumford, with Notices of his Daughter,' by George E. Ellis, also 'Complete Works of Count Rumford,' 4 Vols., published by the American Academy of Arts and Science (Boston, 1876).

‡ 'Cyclopædia of American Biography,' V., p. 345, article Rumford, Benjamin Thompson, Count.

The last century was only a year old when Robert Hare (1781–1858) communicated his discovery of the oxyhydrogen blowpipe to the Chemical Society of Philadelphia. This instrument held a foremost place for the production of artificial heat until the recent introduction of the electric furnace. The application of the principle invented by Hare still finds extensive use for lighthouse illumination and similar purposes under the names of 'Drumond light' and 'calcium light.' It is interesting to recall in this connection that Hare was the first to receive the Rumford medals from the Academy of Arts and Sciences.

Hare was also the inventor in 1816 of a calorimotor, a form of battery by which a large amount of heat was generated, and four years later he modified this apparatus, with which, then known as Hare's deflagrator, in 1823 he first demonstrated the volatilization and fusion of carbon. His memoir on the 'Explosiveness of Niter,' which was published by the Smithsonian Institution in 1850, was one of the earliest contributions by an American to the literature of explosives.†

The original discovery of chloroform is clearly of American origin and must be

* *American Chemist*, V., 1874, p. 73.

† 'Smithsonian Miscellaneous Collections,' II., 1895. Also see the memoir of him by the elder Silliman in the *American Journal of Science* (2), XXVI., 1858, p. 100.

credited to Samuel Guthrie (1782–1848), of Sacketts Harbor, N. Y., whose researches anticipated those of Soubeiran, Liebig and Dumas by nearly a year.

A committee of the Medico-chirurgical Society of Edinburgh gave him the credit for having first published an account of the therapeutic effects of chloroform as a diffusive stimulant. Dr. Guthrie was likewise the inventor of a process for the rapid conversion of potato starch into sugar. He also experimented with considerable boldness in the domain of explosives, inventing various fulminating compounds, which he developed commercially.*

It would be an ungracious task to discuss in this paper the much-controverted 'ether discussion,' but I may say, without fear of doing injustice to any of the several claimants for the honor of the discovery of this important anesthetic, that Charles Thomas Jackson (1805–1880), said to be one of the foremost chemists of his time in this country, claimed from experiments made by himself during the winter of 1841–2 in his own laboratory, that he obtained results showing 'that a surgical operation could be performed on the patient under the full influence of sulphuric ether without giving him any pain.' Four years later (in 1846) this was successfully accomplished by Dr. William T. G. Morton, who had studied chemistry in Dr. Jackson's laboratory. The French Academy of Sciences decreed one of the Montyon prizes to Jackson for his discovery of etherization, and one to Morton for his application of that discovery to surgical operations.†

* An account of his career has been published in pamphlet form by his descendant, Ossian Guthrie.

† Dr. Jackson published a 'Manual of Etherization with the History of this Discovery' (Boston, 1861) and much interesting information is to be had from a 'Report of the House of Representatives of the United States of America, vindicating the rights of Charles T. Jackson on the Discovery of the Anesthetic Effect of Ether Vapor.' The other side of the controversy is given in 'The Discovery of Modern Anesthetics: By whom it was made?' by Laird W. Nevius, New York, 1894.

Metallurgy is little more than the application of chemical knowledge to the extraction of metals from their ores, and I, therefore, beg to claim for the United States the first commercial production of steel. Zerah Colburn, the well-known engineer, gives William Kelly (1811–1888), an iron master of the Suwannee furnaces of Lyon County, Ky., the credit for the 'first experiments in the conversion of melted cast iron into malleable steel by blowing air in jets through the mass in fusion.' Later, when Sir Henry Bessemer made efforts to secure the patent of the process that bears his name, it was decided by the U. S. Patent Office that William Kelly was the first inventor and entitled to the patent, which was promptly issued to him. In 1871, when application was made for a renewal of the patents originally issued to Bessemer, Mushet and Kelly, the last was successful, while the claims of the first were rejected.*

The successful electro-deposition of nickel and its commercial development are chiefly due to the energy of Isaac Adams (1836–), a resident of Cambridge, Mass. He carefully studied the subject and found that the failure to obtain satisfactory results was caused by the presence of nitrates in the nickel solutions previously used. His invention gave rise to prolonged litigation, but in the end he was victorious. Dr. Chandler thus describes it in the fol-

* Much has been written of the claims of Kelly and nearly all of the leading American metallurgists agree in conceding his priority. Swank and various writers in the *Transactions of the American Institute of Mining Engineers* may be consulted. Kelly's own story, as he gave it to the present writer, appears in the *Iron Age*, February 23, 1888, p. 339.

lowing words: "The novel proposition was presented to the court, of a patent for not doing something, namely, for not permitting nitrates to find their way into the nickel solutions employed in nickel plating, and the court held that the exclusion of nitrates was an essential condition of successful nickel plating, and that a process involving this condition was just as patentable as a process involving any other special condition necessary for successful execution, and the patent was sustained."*

In passing I may mention the name of Joseph Wharton (1826–), whose experiments in producing nickel in a pure and malleable condition so that it could be worked like iron culminated in the first production in 1865 of malleable nickel.

Chemistry owes a great debt of gratitude to the genius of Thomas Sterry Hunt (1826–1892) and one of his most notable contributions to technology is the permanent green ink which he invented in 1859 and which is used in the printing of our national bank notes and from the appearance of which the well-known term of 'greenback' was derived. The Hunt and Douglas process for the precipitation of copper by iron, for a time so extensively used for the extraction of copper from low-grade ores, is an invention the credit of which he shares with the well-known metallurgist, James Douglas.

The vulcanization of india rubber by sulphur is the invention of Charles Goodyear (1800–60), who was so persistent in his efforts as to become an object of ridicule. Indeed, he was called an india rubber maniac and was described as a 'man with an india rubber coat on, india rubber shoes, and in his pocket an india rubber purse, and not a cent in it.' His invention consisted in mixing with the rubber a small quantity of sulphur, fashioning the articles from the plastic material and curing or vulcanizing the mixture by exposure to the temperature of 265–270° F.*

Of almost equal importance was the invention of hard rubber or vulcanite, for which Nelson Goodyear (1811–57), a brother of Charles Goodyear, obtained a patent in 1851, claiming that the hard, stiff, inflexible compound could be best obtained by heating a mixture of rubber, sulphur, magnesia, etc., but this never became an article of commerce. In 1858 Austin Goodyear Day (1824–89) patented a mixture of two parts of rubber and one of sulphur, which, when heated to 275–300° F., yielded the flexible and elastic product now generally known as hard rubber.†

Dr. Leander Bishop has said: 'In the art of modifying the curious native properties of cautchouc and gutta percha, and of molding their plastic elements into a thousand forms of beauty and utility, whether hard or soft, smooth or corrugated, rigid or elastic, American ingenuity and patient experiment have never been excelled.‡

Exceedingly valuable to the industries of this country was the influence of James Curtis Booth (1810–88), who from 1849 till his death was melter and refiner in the U. S. Mint. In 1836 he established a laboratory in Philadelphia for instruction in chemical analysis and chemistry applied to the arts, and in the course of a few years gathered around him nearly forty students, among whom were Martin H. Boyé, John F. Frazer, Thomas H. Garrett, Richard C. McCulloh and Campbell and Clarence Morfit, all of whom have achieved eminence as chemists. It was said of him, 'that Mr.

* *Journal of the Society of Chemical Industry*, XIX., 1900, p. 611.

* His life has been published by Bradford K. Peirce with the title, 'Trials of the Inventor,' New York, 1860.

† *American Chemist*, II., 1872, p. 330.

‡ 'A History of American Manufactures,' by J. Leander Bishop (Philadelphia, 1860).

Booth had few, if any, superiors as a teacher of practical chemistry.' From 1836 till 1845 he held the chair of chemistry applied to the arts in the Franklin Institute, delivering three courses of lectures extending over three years each. He was the author of an 'Encyclopædia of Chemistry' (Philadelphia, 1850) and with Campbell Morfit of a report 'On Recent Improvements in the Chemical Arts,' published by the Smithsonian Institution in 1852. His appointment to the mint was coincident with the discovery of gold in California, and the new processes required to prepare the bullion for coinage were largely of his own invention and many of them, to use his own words, 'were not known outside the mint.'*

It is well known that prior to 1850 and for some time thereafter Philadelphia was the acknowledged center for the manufacture of chemicals for medicinal use. To collect the details of the many improved methods for the production of these chemicals would be a long and difficult task, and would require more space than I have at my command in this article. The names of such firms as Powers, Weightman and Rosengarten and Sons are readily recognized as those of manufacturers of standard chemicals. M. I. Wilbert has recently published a paper, entitled 'Early Chemical Manufacturers: A Contribution to the History and Rise of the Development of Chemical Industries in America,' to which I must refer you for further information concerning their growth and progress.†

I am reminded in this connection that the name of Edward Robinson Squibb (1819–1900) is one well worthy of deserved recognition among manufacturers of chemicals. The ether prepared by him by processes of his own invention has long been accepted as standard. For a brief period during the early fifties of the last century Dr. Squibb was associated with J. Lawrence Smith (1818–83) in Louisville, Ky., in the commercial production of chemical reagents and of the rarer pharmaceutical preparations.* It is also proper to add the name of the Baker and Adamson Chemical Company of Easton, Pa., as that of a corporation which has established a reputation for the manufacture of pure chemicals by processes, many of which are of their own devising. The success of this young firm is generally admitted to be due to Edward Hart (1854–), who fills the chair of chemistry in Lafayette College.

Eben Norton Horsford (1818–93) made distinct contributions to technical chemistry and among these may be mentioned his invention of condensed milk. According to Charles L. Jackson, he originally prepared this most valuable article of food for use in Dr. Kane's Arctic expedition and afterwards presented the process to one of his assistants, who then sold it to Gail Borden. His name, however, is more commonly associated with his invention of a phosphatic yeast powder, the object of which is to return to the bread the phosphates lost in bolting the flour, and which, as is well known, form such an essential constituent of the food of animals. He also devised 'a marvelously compact and light marching ration of compressed beef and parched wheat grits,' which found some use at the time of the Civil War, and his name is also attached to the preparation

* A sketch of his career by Patterson Du Bois was presented before the American Philosophical Society on October 5, 1888, and has since been issued as a separate of eight pages.

† *Journal of the Franklin Institute*, CLVII., 1904, p. 365.

* See 'Original Researches in Mineralogy and Chemistry,' by J. Lawrence Smith (Louisville, Ky., 1884), p. xxxviii.

of 'acid phosphate,' so commonly used with summer beverages.*

The development of the mineral resources of our country has been due largely to those who from their knowledge of chemistry were able to recognize the commercial value of the natural deposits in the vicinity of their homes. This has been conspicuously the case with the great fertilizer industry of the south, and especially so in South Carolina, where the names of Charles Upham Shepard (1804–86) and St. Julien Ravenel (1819–82) are recognized as those of pioneers in that important branch of chemical industry.

To quote from Silliman again, and he is always an acceptable authority, "No observation or original research of Dr. Shepard has been fruitful of so much good in its consequences as his discovery of the deposits of phosphate of lime in the Eocene marl of South Carolina, and the distinct recognition of its great value for agriculture."† It was Dr. Ravenal, however, whose experiments made it possible to transform these phosphate rocks into commercial fertilizers, and of him the younger Shepard wrote in 1882: "Well might this community erect a public monument in honor of the man to whom preeminently is due the inauguration of that phosphate industry which has proven of such incalculable value to ourselves and others. As the statue of Berzelius adorns beautiful Stockholm, let us commemorate [similarly] the founder of Charleston's greatest industry." It may be added that Dr. Ravenel differed from the agricultural chemists of his time in devoting greater attention to the physiological phases of the application of fertilizers to plants than to the mere

* A sketch of his career prepared by Charles L. Jackson appeared in the *Proceedings of the American Academy of Arts and Sciences*, XXVIII., 1903, p. 34.

† *American Chemist*, V., 1874, p. 96.

chemistry of the subject; this was naturally due to his early training in medicine. *

It would lead me too far from chemistry, perhaps, to discuss the work of the younger Shepard (1842–) in successfully introducing tea culture into the United States, but his farm in Summerville, S. C., is a monument to the application of his chemical knowledge to a new industry, and well may his fellow-countrymen be proud of the results.

It is desirable to mention at this place the remarkable successes achieved by a small band of chemists who spent the four years of our Civil War in their southland. George Washington Raines (1817–98), John Le Conte (1818–91), Joseph Le Conte (1823–91) and John William Mallett (1832–) are among the more conspicuous names that occur to me. It was Raines who erected at Augusta, Ga., the Confederate powder works, which at the close of the war were regarded 'as among the best in the world.'†

The Confederate government appointed John Le Conte to the superintendency of the extensive niter works established in Columbia, S. C., which place he retained during the war. ‡ Joseph Le Conte, a younger brother, served as chemist to the Confederate laboratory for the manufacture of medicines in 1862–3, and also in a similar capacity to the niter and mining bureau in 1864–5. Professor Mallett was

* Two memorial pamphlets of Dr. Ravenel have been published. One, entitled 'In Memoriam, St. Julien Ravenel, M.D.' (9 pp.), is a reprint of an editorial from the Charleston *News and Courier* of March 18, 1882. The other, entitled 'Dr. St. Julien Ravenel,' is a memorial published by the Agricultural Society of South Carolina, Charleston, S. C. (54 pp.).

† He published in pamphlet form a 'History of the Confederate Powder Works' (Augusta, 1882).

‡ 'Biographical Memoirs,' National Academy of Sciences, III., p. 369.

in charge of the ordnance bureau of the Confederate states, serving with the rank of colonel. He has described his experience under the title 'Applied Chemistry in the South during the Civil War,'* which he has delivered as a lecture before various chemical societies.

A history of the manufacture of explosives in this country would carry us far into the past, for the oldest of the still existing powder mills was established in 1802 by Eleuthere Irene Du Pont and the name of Du Pont is still honorably associated with the industry, for so recently as 1893 two of that name received a patent for a smokeless powder which is now largely made at works near Wilmington, Del.

During the years 1862–4 Robert Ogden Doremus (1824–) developed the use of compressed granulated gunpowder, which was adopted by the French government. It was concerning this inventor that Sir Frederick A. Abel in 1890 in his retiring address before the British Association said that Doremus 'had proposed the employment in heavy guns of charges consisting of large pellets in prismatic form.' Charles Edward Munroe (1848–) must be recognized as the first in the world to prepare a 'smokeless powder that consisted of a single substance in a state of chemical purity.' This explosive, which he invented while chemist at the U. S. Torpedo Station, Rhode Island, and which became known as the 'naval smokeless powder,' was referred to by Secretary of War Tracy in 1892 as presenting 'results considerably in advance of those hitherto obtained in foreign countries.'†

* An abstract of this paper with the title 'Industrial Chemistry in the South during the Civil War' is contained in the *Scientific American* for July 25, 1903.

† The history of the 'Development of Smokeless Powders' was the subject of Dr. Munroe's presidential address before the Washington Section of the American Chemical Society in 1896. See *Journal of the American Chemical Society*, XVIII., 1896, p. 819.

Of later development is the Bernadou powder invented by John Baptiste Bernadou (1858–), of the U. S. Navy, and which it is claimed has been adopted for use in the naval branch of the service.

No contribution to the history of technical chemistry in the United States would be complete without some reference to the development of coal oil and petroleum. It seems almost impossible to realize that scarcely half a century ago the only use of petroleum was as a cure for rheumatism under the name of Seneca oil. The commercial exploitation of this important illuminant is, of course, largely due to the Standard Oil Company and to the expert chemists in their employ credit should be given for the production of the many beautiful by-products that are now made. A full description of these with proper reference to the chemist to whom we are indebted for them would, indeed, be valuable, but even for a simple enumeration of the products in tabular form giving their immediate origin I must refer you to the text-books on industrial chemistry.*

One of the most interesting of these many compounds is vaseline, whose use in pharmacy is so prevalent. It was invented in 1870 by Robert Augustus Chesborough (1837–). Charles Frederick Mabery (1850–) has been an indefatigable worker in the theoretical branch of the subject, especially on the composition of petroleum, in the study of which he has been aided with grants from the C. M. Warren Fund for Chemical Research of the American Academy of Arts and Sciences. Stephen Farnam Peckham (1839–) has been a prolific contributor to the literature of the technology of the subject,

* See 'A Handbook of Industrial Chemistry,' by Samuel P. Sadtler (Philadelphia, 1900), p. 21.

and his report on petroleum, prepared for the tenth census (Washington, 1880) is standard authority. Another chemist who has studied petroleum both in the laboratory and also from a commercial point of view as well, is Samuel Philip Sadtler (1847–). His 'Industrial Organic Chemistry' (Philadelphia, 1900) gives a very satisfactory survey of the subject with an admirable bibliography. Among the younger men I learn that William Cathcart Day (1857–) has succeeded by carrying out operations of distillation at the ordinary atmospheric pressure upon animal and vegetable matter, both separately and mixed, in obtaining three different materials, all of which present in different degrees the properties characteristic of asphalts.*

An early worker in the scientific part of this subject was Cyrus More Warren (1824–91), whose original researches on the volatile hydrocarbons and similar bodies resulted in many practical applications in the use of coal tar and asphalt, especially for roofing and paving purposes. Clifford Richardson (1856–) has in recent years devoted much attention to the study of asphalt and is a recognized authority on its value for commercial purposes.

I can not claim for the United States the invention of illuminating gas, although as early as 1823, its manufacture was begun in New York city, but the development of the production of a luminous water gas was largely accomplished in this country. According to excellent authority,† Thaddeus S. C. Lowe (1832–) built and successfully conducted gas works in Phœnixville, Pa., in 1874, producing a water gas 'far superior to that made from coal.' According to Dr. Chandler 'there are forty or fifty differing forms of apparatus for manufacturing [water gas], but they are almost without exception applications of the invention of Thaddeus Lowe.*

Those of us whose memories extend back for a quarter of a century may recall Tessie de Motay (1819–80), whose agreeable personality charmed all of those who were so fortunate as to meet him, and to him is due the production of water gas in the late seventies of the last century by a process of his own invention in New York city.†

A much-needed substitute for ivory and horn that could be produced economically was invented in 1869 by John Wesley Hyatt (1837–) and called by him celluloid. It is so seldom that foreign recognition is unqualifiedly given to our American inventors that I am glad of the opportunity to quote Thorpe,‡ who says, concerning celluloid, that it 'is an intimate mixture of pyroxlin (guncotton or collodion) with camphor, first made by Hyatt of Newark, U. S., and obtained by adding the pyroxlin to melted camphor * * * and evaporating to dryness.' Its many applications in various industries are so well known as to need no further mention here.

It should not be forgotten that saccharin, a coal tar compound with a sweetening

* *Journal of the Franklin Institute*, September, 1899, p. 205.

† See a 'Communication on the Lowe Gas Process,' New York (May, 1876) and 'A Communication on the Lowe and Strong Gas Processes' of later date (probably 1878) and also 'The Chemistry of Gas Lighting,' by C. F. Chandler (Philadelphia, 1876), a reprint from the *American Chemist* for January and February, 1876. There is also a pamphlet report on the 'History and Value of Water Gas Processes' (New York, 1864) by John Torrey and Carl Schultz which gives a brief summary of some sixty patents on the subject.

* *Journal of the Society of Chemical Industry*, XIX., 1900, p. 613, where also excellent descriptions of both the Lowe and the Motay processes are to be found.

† See sketch of Cyprien M. Tessie de Motay by A. J. Rossi in the *Journal of American Chemical Society*, II., 1880, p. 305.

‡ 'Dictionary of Applied Chemistry,' I., 1891, p. 449.

power of about five hundred times that of cane sugar, although now manufactured chiefly in Germany, was discovered in 1879 in the laboratory of the John Hopkins University by Constantin Fahlberg, a student under Ira Remsen (1846–) and the Society of Chemical Industry in 1904 crowned Remsen's work by conferring upon him the medal of the society, recognizing thus for the first time in its history the discoveries of an American chemist.

In the domain of technical chemistry no American has ever achieved greater results than Hamilton Young Castner (1858–99), and the opportunity of presenting a brief summary of his brilliant inventions is a pleasure that I gladly welcome.

His first invention was a continuous process for the manufacture of bone charcoal, but this failed of commercial success, although scientifically of much interest, and he then turned his attention to the study of an improved method for the production of aluminum. To accomplish this it was necessary to produce sodium economically, and this he succeeded in doing by using carbide of iron as a reducing agent. When he began this now historic research the market price of aluminum was $10 a pound, and when his process was completed he was able to manufacture aluminum at about one dollar a pound. "This," says Dr. Chandler, "revolutionized the whole industry and aluminum could be now used for a hundred different purposes." In his retiring address before the British Association in 1890 Sir Frederick A. Abel said: "The success which has culminated in the admirable Castner process constitutes one of the most interesting of recent illustrations of the progress made in technical chemistry."

But there were other uses for which sodium could be employed, and so he invented a process for converting metallic sodium into sodium peroxide. Then came the suggestion that with cheap sodium pure cyanides could be produced, and so he modified his process so as to manufacture pure cyanides, especially the potassium and sodium cyanides, enormous quantities of which were used for the extraction of gold from low-grade ores. His active mind was ever busy with new solutions of chemical problems, and subsequent to the invention of electrolytic processes for the reduction of aluminum, Castner concentrated his attention on the original methods used by Sir Humphry Davy and overcoming the difficulties encountered by that great chemist he soon devised an electric process of remarkable simplicity for obtaining metallic sodium from caustic soda by electrolysis. His ambition was not yet satisfied and he added to his triumphs a beautiful method for the electrolysis of common salt with the production of caustic soda and bleaching powder. Thus Castner invented 'the first process which could be said to be a complete success; for accomplishing what French, German, English and American chemists had been working at for a hundred years.' Again to quote Chandler:* 'He never worked on a chemical process that he did not invent a better one to accomplish the same result.'

The silver metal and the white crystals, pure and beautiful, the results of his many hours of study and research, will always preserve in the literature of chemistry the memory of him of whom it is surely not too much to say that he was the most eminent of American inventors in chemical technology in recent times.

While Castner was studying the problem of preparing aluminum by chemical methods Charles Martin Hall (1863–),

* See the 'Unveiling of a Bronze Tablet in Havemeyer Hall to the Memory of Hamilton Young Castner, December 16, 1902,' *School of Mines Quarterly*, XXV., January, 1904, p. 204.

a student in Oberlin College, conceived the plan of extracting aluminum by electrolysis and he found that a melted bath of the double fluorides of aluminum and metals more electro-positive than aluminum, such as sodium or calcium, was a perfect solvent for alumina, and from such a solution he was able to separate the aluminum by means of the electric current. It is by this process that all of the aluminum of commerce is produced to-day.

Moissan, whose extended researches with the electric furnace have made his name justly famous, writes: 'The discovery of crystalline carbon silicide belongs to Acheson.'* This remarkable abrasive, prepared by heating a mixture of silica, coke, alumina and sodium chloride in an electric furnace, was invented in 1890 by Edward Goodrich Acheson (1856–) while experimenting for the artificial production of diamonds, and is one of the many beautiful products obtained at Niagara Falls, where quite a number of chemical manufacturers have established their plants in order to take advantage of the power obtained from the great waterfall. Mr. Acheson has also succeeded in preparing artificial graphite as a by-product in the manufacture of the carborundum, and he claims that it is the result of the decomposition of the carbide formed in that process.†

Although the existence of calcium carbide has been recognized ever since its original production in 1857 by Edmund Davy, Wöhler and Berthelot, it was not until May, 1892, that its commercial production became known in consequence of its chance discovery by Thomas Leopold Willson (1860–) while experimenting in Spray, N. C. He obtained it by the fusion and reduction in an electric furnace of a mixture of finely powdered and intimately mixed lime and coke. When it comes in contact with water decomposition ensues with the production of acetylene gas, an illuminant of remarkable power. This valuable compound is also manufactured at Niagara Falls.

* 'The Electric Furnace' (Easton, 1904), p. 273.

† *Journal of the Society of Chemical Industry*, XIX., 1900, p. 609.

Another valuable application of the high temperatures obtained by the electric furnace to substances from which the extraction of the metal was formerly considered impossible is the method patented in November, 1903, by Frank Jerome Tone (1868–), of Niagara Falls, N. Y., for obtaining metallic silicon by reducing silica with carbon in an electric furnace of his own construction.

Of great value is the elaborate bulletin* on 'Chemicals and Allied Products' prepared for the twelfth census by Charles Edward Munroe, already mentioned, and Thomas Marcau Chatard (1848–). The industries discussed are grouped into nineteen classes and with each the discussion is introduced by a history of the development of the manufacture in the United States, and at the close is a brief bibliography. The volume includes a digest of United States patents relating to the chemical industries.

Worthy of the most distinguished consideration is the career of Charles Frederick Chandler (1836–). This eminent chemist has since 1864 taught the technical chemistry in the Schools of Science in Columbia University and no record of the development of chemistry applied to the arts in the United States would be complete without mention of his work. It is true that no great invention bears his name, but he has achieved results greater than inventions, for he has educated chemists, and yet even more than that as we shall see. Go where you will and you will find busy workers in science who have learned from

* Census Bulletin, No. 210. Quarto, 306 pp. Washington, June 25, 1902.

Chandler something of that splendid power of applying chemical methods to the subject at hand which has long since gained for him the reputation of being the foremost authority on technical chemistry in the United States. Wherever gold or silver is determined, the little assay ton weights—their conception was a stroke of genius—claim him as their inventor. The brilliant series of articles on technical chemistry—the best in the English language—that appeared in Johnson's Cyclopedia were written by him. The first museum of applied chemistry in the United States where the crude material may be studied in its course of development to a finished product was established by him. Masterly, indeed, are the practical contributions to chemistry which marked the years during which he had charge of the public health in New York city. It resulted in enormous benefits to the community, and in 1883 it was well said: 'There is no other city in the world which has so complete a sanitary organization as New York'; for all of which credit is due to Chandler.* In 1889 he was chosen president of the Society of Chemical Industry, the first American upon whom that honor was conferred, and a year later, on June 18, 1900, in the lecture theatre of the Royal Institution founded by Count Rumford, to whom reference has already been made, he delivered his presidential address on 'Chemistry in America,' in the course of which he elaborated most fully the achievements of those who have distinguished themselves in that branch of science in the United States.†

* See the sketch of Charles Frederick Chandler by the present writer in the *Scientific American*, LVII., July 16, 1887, p. 39, and 'President Chandler and the New York City Health Department, 1866–1883,' in the *Sanitary Engineer*, May 17, 1883.

† *Journal of Society of Chemical Industry*, XIX., 1900, p. 591.

It is worth while, I think, to mention very briefly three branches of our national government that have had much to do with the development of chemical technology in this country. The first of these and also the oldest, for it celebrated its centenary in 1891, is the patent office,* where inventors receive the protection of the government for their discoveries. By thus recognizing worthy inventions a valuable stimulus is given to invention which has not been without value to the community. Of exceptional interest to chemists is the system of indexing chemical literature now in use in the classification division of the patent office.†

I will also call your attention to the excellent work done in the Division of Mineral Resources in the U. S. Geological Survey, where under the efficient direction of David Talbot Day (1859–) valuable information and statistics are gathered concerning native minerals and ores from which are obtained the products of so many of the leading chemical processes.‡

Finally the bureau of chemistry of the Department of Agriculture has been a potent factor in the development of chemical industries. It was this bureau that first called the attention of the public to the possibility of establishing the beet sugar industry in the United States. As a result of the investigations carried on by chemists in this branch of the government service the average yield of cane sugar to

* 'Patent Centennial Celebration, 1891: Proceedings and Addresses,' 554 pp. (Washington, 1892).

† See 'On a System of Indexing Chemical Literature; Adopted by the Classification Division of the United States Patent Office,' by E. C. Hill, *Journal of the American Chemical Society*, XXII., 1900, pp. 478–498; also *Scientific American*, LXXXVI., June 14, 1902, p. 411.

‡ Beginning with the year 1882, annual volumes of the Mineral Resources of the United States have been published.

the ton in the state of Louisiana has been increased from 130 pounds to 170 pounds. In the examination of road materials important contributions to technical chemistry have been made by this bureau. The valuable studies on the dietetic value of foods and on their adulterations, conducted under the direction of Dr. Harvey Washington Wiley (1847–) have not only done much towards creating a demand for the enactment of national legislation for pure food, but they have also been praiseworthy contributions to the application of chemistry to sanitation. This bureau also should receive recognition for its fostering influence over the Association of Official Agricultural Chemists, an organization which has done so much to secure uniform methods of analysis of fertilizers and of foods.*

To Henry Carrington Bolton (1843–1903) is due the credit for the series of bibliographies of the literature of the chemical elements that have been published by the Smithsonian Institution. His own memory will always be worthily preserved by the splendid 'Bibliography of Chemistry' in four octavo volumes, an important section of each of which is devoted to technical chemistry.

The records of the past give abundant hope for the future.

Marcus Benjamin.

U. S. National Museum.

THE PHYSIOLOGICAL SECTION OF THE CENTRAL BRANCH OF THE AMERICAN SOCIETY OF NATURALISTS.

A physiological section of the Central Branch of the American Society of Naturalists was organized and held enthusiastic meetings on March 31 and April 1 during the recent meeting at Chicago. The sectional meeting was called to order in the Hull Physiological Laboratory and Professor G. N. Stewart was chosen chairman.

The following papers were presented:

Changes in the Percentage of Water in the Central Nervous System of the White Rat between Birth and Maturity: H. H. Donaldson.

Between birth and one year of age the percentage of water in the brain of the white rat falls from approximately 89 per cent. to 77 per cent., and in the spinal cord from 86 per cent. to 69 per cent.

In the brain the rapid decrease occurs during the first seventy days of life, while in the cord this period is somewhat more prolonged.

Taking the converse change of increase in solids, it is found that in both the brain and the cord the solids increase more rapidly than does the weight of the organ, a relation probably dependent on the process of medullation.

In general, the percentage of water in the central nervous system is very closely correlated with the age of the animal, and almost independent of its absolute body weight.

On the Presence of a Sulphur Compound in Nerve Tissues: Waldemar Koch.

Kossel first called attention to the fact, later confirmed by Cramer, that all preparations of protagon contained sulphur. Thudichum isolated an impure barium salt containing four per cent. of sulphur, which he classed as a cerebrosulphatid.

A comparison of the organically combined sulphur (not proteid sulphur) present in various tissues gives the following result expressed in parts per million: Spinal cord, 1,029; liver, 470; striated muscle, 310; testicle, 209; submaxillary gland, 135. These figures point very

* The literature issued by the Bureau of Chemistry is large and includes nearly one hundred important bulletins and many minor circulars and leaflets.

strongly to a sulphur metabolism in the nervous system, as even the liver, which is supposed to play such an important rôle in sulphur metabolism, contains only half as much as the spinal cord. Results indicate that the sulphur compound or compounds exist in the nervous system partly combined and partly free; in the liver they are not combined. Attempts to isolate and purify for analysis a compound containing sulphur have so far been only partially successful on account of the extremely poor yields. A barium salt was obtained, resembling Thudichum's compound, but containing more nitrogen. With regard to solubility and chemical reactions the compound agrees best with Cloetta's uroproteic acid. My barium salt contains, however, twice as much sulphur as Cloetta found, and, besides, a very considerable amount of phosphorus, which either represents an impurity in every case or was present in Cloetta compound also, but not detected by him. My compound calculated as the free acid gives approximately the following formula, $C_{60}H_{120}N_{12}S_2PO_{40}$, as compared with Cloetta's $C_{66}H_{116}N_{20}SO_{54} + nH_2O$. The investigation will be continued as soon as more material is available.

The Excretion of Nitrogen by the White Rat According to Weight and Age: SHINKISHI HATAI.

A cage for collecting urine and feces separately was especially constructed for the present work. The animals were kept for three days in the cage and were fed exclusively with Uneeda biscuit and water. From the observations on 89 rats, which ranged from 32 grams up to 382 grams, the following results were obtained:

1. The total amount of urine increases with the body weight up to 120 grams, then decreases very decidedly. From 180 grams it again ascends up to 220 grams, where it remains rather constant.

2. The total amount of nitrogen is quite independent of the amount of urine. It increases constantly and continuously as the animals grow in weight. When the total amount of nitrogen is plotted on base line according to the body weight the curve thus obtained presents an approximately straight line. On the other hand, the curve on base line according to age presents a distinct period of rapid rise up to somewhere between 200 grams to 240 grams.

3. About 91 per cent. of the total nitrogen in the case of the young and 89 per cent. in the larger represent the urinary nitrogen.

4. The total amount of nitrogen eliminated by rats of different weights during 24 hours can be determined with a high degree of accuracy by the formula

$$\log N = \frac{233 + \log B. W. \times 3}{4}$$

where N = total nitrogen in milligrams and B. W. = body weight in grams.

Further Evidence of the Fluidity of the Conducting Substance in Nerves: A. J. CARLSON.

The pedal nerves of gasteropods (*Ariolimax*) and the ventral nerve-cord of worms (*Bispira*) have relatively great elasticity and may be stretched to nearly twice their shortest length without impairing their function or altering their condition sufficiently to cause stimulation. This stretching does not affect the intensity of the impulse conducted through the nerves, as shown by the muscular response. But the time required for the impulse to travel through the nerve increases in proportion to the degree of stretching of the nerve in such way that delay in time is directly compensated by the additional length of the nerve in the stretched condition, so that the actual rate of propagation of the nervous impulse remains the same in the stretched and the relaxed nerve or nerve-cord. The increase in the transmission-time shows that the stretching is not merely a straightening out of kinks or folds in the nerve-fibers. The conducting substance must be actually extended. But this extension of the conducting substance is effected without inducing any changes of stress or tension in it, because the process (nervous impulse) conducted by it is not altered. Such an extension of conducting substance can be effected only in case it is in a fluid condition.

The Antagonistic Action of Calcium to Barium, and of Calcium and Barium to Veratrin, on the Mammalian Heart: S. A. Matthews.

Calcium salts and barium salts show the same antagonism as regards the mammalian heart as Sydney Ringer observed on the heart of the frog. Further, both calcium and barium are antagonistic to veratrin. Barium shows a greater antagonism to veratrin than calcium, but owing to the marked poisonous properties of barium in sufficient doses to counteract the veratrin effects, calcium is necessary to check in part the barium effects, and the antagonism to veratrin is more complete if a solution of $m/2,000$ $BaCl_2$ made up in an $m/8$ $CaCl_2$ solution be injected. This also corroborates Ringer's results on the frog's heart.

Determination of Freezing Point of Small Quantities of Liquid, Especially for Clinical Purposes: T. M. Wilson.

Dr. G. N. Stewart suggested that it would be worth while to investigate whether by using a small tube and adding to a small quantity of a solution whose freezing point was to be determined a quantity of a liquid which does not exert osmotic pressure (clean mercury, *e. g.*) sufficiently large to insure complete immersion of the thermometer bulb, fairly satisfactory readings might not be obtained. By performing all the manipulations in a definite way, and, in particular, keeping the degree of undercooling about the same in successive observations, it was found that this was the case. Comparison of the results obtained on a standard salt solution by this method and by the ordinary method showed that readings reliable to the hundredth of a degree centigrade could be got with as little as 0.3 c.c. of solution. The determinations are, of course, less accurate than those made with 10 or 15 c.c., but the method will, it is hoped, permit the approximate measurement of the freezing point of such quantities of blood or serum or of the rarer animal liquids as are easily available for clinical purposes, without diluting with water or salt solution, a procedure to which there are weighty objections.

Preliminary Report on an Attempt to Determine the Oxidizing Coefficients of Different Tissues: H. McGuigan.

The tissues of the body are known to differ in their oxidizing powers. The attempt was made to express the comparative oxidizing powers of the more common sugars in terms of electro-chemical units, with the hope of getting data from which to compute the voltage necessary to relieve the enzymes of their charges and thus indirectly obtain their oxidizing powers (see A. P. Mathews, *Am. Jour. Physiol.*, Vol. X., p. 450). Comparative figures were obtained for lactose, maltose, glucose, galactose and levulose.

Neutral copper acetate will oxidize all of the above sugars in the order given, lactose being the most difficult. The addition of known quantities of acetic acid will prevent the oxidation. The volume of the acid sufficient to do this differs for each of the sugars, increasing from lactose to levulose in the order given above. The constants were taken from the formula:

$$\frac{\text{Cu acetate}\cdot v\frac{100}{a}}{v.\ \text{acetic acid}\cdot\frac{100}{\beta}}=K$$

where v is the dilution, a the percentage of copper hydrate at 100° C., and β the percentage of ionized acetic acid. The following values of K were obtained:

Levulose	0.0276
Galactose	0.0185
Glucose	0.0176
Maltose	0.0096
Lactose	0.0078

If we determine K for Barfoed's reagent in the same way, considering that in the use of it we would dilute it about one half, we get 0.0130. This places it between the mono- and disaccharides, where it should be theoretically.

Artificial Production of Heart Rhythm: David J. Lingle.

Physiologists believe rhythmic activity can be revived in heart muscle by electrical, mechanical and chemical agencies. These ideas are based on work done by experimenters who ignored the rôle of salt solutions in producing rhythms and used a sodium chloride solution to hold or moisten a heart strip when testing the power of an agent to make it beat. As a sodium chloride solution of itself has this power, a result obtained under these conditions is unsatisfactory because the agent tested has been made to act with another capable of producing the result.

The inference, from work of this kind, that a constant current is a rhythm producer, is not correct. Because when the same constant current is made to pass through two similar strips from the same heart, one in a moist chamber, the other in air, a rhythm appears only in the latter, which is moistened with NaCl solution, to prevent drying. The other strip with the same current, but without the NaCl solution, remains quiet. (In this experiment the non-polarizable electrodes should be moistened with LiCl solution, otherwise they may hold enough NaCl to start a rhythm.)

The same is true of strips treated with induction shocks, either slowly repeated or tetanizing. With a NaCl solution they start rhythms, but without it they do not. Mechanical tension, either constant or intermittent, will cause rhythms if the suspended strips are moistened with a NaCl solution, but it fails without this. It would seem, then, that the rhythm-producing power of electrical and mechanical agents of this kind is due entirely to the NaCl solution used along with them.

No work along this line has been done to test the powers of the various chemical agents. But as most of these have been used with a solution of NaCl, it will be found, in all probability, that they are not exceptions. Most of them are simply compounds that do not interfere with the action of the NaCl used with them, rather than real rhythm producers.

Experiments on Resuscitation: C. C. Guthrie and G. N. Stewart.

Kuliabko's work on resuscitation of the excised mammalian heart after a long interval led us to undertake resuscitation experiments in entire animals. These were begun in the autumn of 1902.

After five to fifteen minutes' complete stoppage of the heart (determined by inspection) by asphyxia, drowning, ether, chloroform or electrical currents, in many cases an efficient circulation was reestablished. A combination of artificial respiration, heart massage, occlusion of the aorta and arterial injection of defibrinated blood gave the best results.

Disappearance of the pulse as determined by palpation or by the manometer curve does not coincide with complete stoppage of the heart. We saw restoration up to forty-four minutes after the pulse ceased to be felt. Doubtless the period of complete stoppage was shorter.

Before proceeding further it seemed advisable to determine the limit after which resuscitation is possible in particular organs and tissues, especially in the brain and cord. In cats the chest was opened and the innominate and left subclavian arteries, and the aorta immediately below the origin of the left subclavian, were clamped. Artificial respiration was maintained. The heart continued beating well for a considerable time. The reflexes disappeared usually in ten to thirty-five seconds, the respiration about the same time, a few gasps following for a minute or two more. The innominate and left subclavian were released after varying intervals, the aorta remaining clamped. The functions of the anterior part of the animal (including the brain and cervical cord) returned after an interval which was longer the greater the period of occlusion, but dependent also on the efficiency of the circulation. The longest interval after which complete restoration (including voluntary movements, eye reflexes, etc.) has been hitherto obtained is twenty-five and a half minutes. After a fifty minutes' occlusion* excellent respiratory movements returned, together with strong reflex movements of the fore limbs, including good crossed reflexes, jaw reflexes and violent general spasms of the whole anterior part of the animal. The eye reflexes were not restored nor were we certain that any voluntary movements returned.

The symptoms appear in a fairly definite order: (1) some constriction of the pupil; (2) twitching of skin over shoulders, on lower jaw or head or in the tongue; (3) gasping movements of jaws rapidly increasing in intensity and rate, and soon involving neck, shoulders, chest and fore limbs; (4) eyelid, light, and fore limb reflexes, the latter first confined to the limb struck, but later crossed. The reflex excitability of the anterior portion of the cord is abnormally great; (5) extensor spasms of fore limbs, neck and head (usually opisthotonus); (6) voluntary movements of head, eyes and limbs.

We do not know whether animals after such a long period permanently survive. A cat in which all symptoms of complete anemia of the anterior part of the body were present for five minutes after occluding the innominate and left subclavian arteries, artificial respiration being kept up through a tube inserted through the glottis, recovered completely, although the extensor spasms after the anesthesia had passed off were marked. Another cat after ten minutes' complete anemia had severe spasms and croupy respiration for some hours. The spasms and dyspnœa do not depend on any lack of oxygen in the blood, shown by the appearance of the gums, tongue, etc., and they are not relieved by oxygen inhalation. This animal rapidly recovered, showing only some paralysis of the right limbs, which gradually improved.

Some preliminary experiments have been made on the maintenance of an artificial circulation through the isolated head with the view, among other points, of ultimately investigating the question of cerebral vasomotors. In one case the eye reflexes were still obtained with artificial circulation of defibrinated blood after about nine minutes. As the blood had been kept in the ice box for twenty-four hours after being used for a previous experiment, and as this was one of our earlier experiments, there is no doubt that a much better result can

* This experiment was performed after the presentation of our paper.

be got. Defibrinated blood was found to be better than Locke's solution.

The Nature of Cardiac Inhibition, with Special Reference to the Heart of Limulus: A. J. CARLSON.

It is commonly believed to-day that the cardio-inhibitory nerve-fibers act directly on the heart muscle. This view is a corollary of the myogenic theory of the nature of the heart-beat. In *Limulus* the heart beat is neurogenic. The cardio-inhibitory nerves act on the local heart ganglion in a way to stop or diminish its activity and do not act directly on the heart muscle. This conclusion rests on the following evidence: (1) stimulation of the nerves that pass from the cardiac ganglion to the heart muscle produces motor and not inhibitory effects; (2) the diminution of the excitability of the heart during complete inhibition is the same as after extirpation of the heart ganglion; total inhibition thus amounts to throwing the ganglion out of function; (3) atropin paralyzes the cardio-inhibitory nerves only in case it comes in contact with the heart ganglion, but not if it comes in contact with the heart muscle and the nerves passing from the ganglion to the heart muscle.

Weber's theory of the nature of the cardiac inhibition is thus shown to be true for the *Limulus* heart. Stimulation of cardio-inhibitory nerves in *Limulus* produces the same effects as those produced in the vertebrate heart by stimulation of the vagi. The mechanism of cardiac inhibition in vertebrates probably does not differ from that in *Limulus,* as all the changes produced in the heart by the stimulation of the vagi can be accounted for on Weber's theory. Cardiac inhibition is, therefore, to be referred to the category of inhibitory processes known to take place in the central nervous system, that is, the inhibition of one neural process by another.

Effects of Simultaneous Section of Both Vagi above the Origin of the Recurrent Laryngeal: G. N. STEWART.

1. At the Madrid International Congress of Medicine (April, 1903) Ocaña showed a dog which, ten weeks after this operation, was in perfect health. It remained so for more than six months. He supposes that this was the first instance of such a result. In November, 1900,* however I described similar cases. In February, 1897, a dog was operated on, which lived in excellent health for many months. An account of this animal was sent on March 31, 1897, to a friend for insertion in an eastern medical journal, but was not considered suitable. At the autopsy I found the two portions of the left vagus still separated by a wide interval. In the right vagus such perfect union had taken place that only a fine linear scar remained, barely visible to the eye, but easily recognizable with the aid of a hand lens, and still better on microscopical examination of longitudinal sections. Such instances of perfect recovery and long survival are quite rare, at least in this climate (two, or at most three, cases out of sixty dogs, in my experience). Whether they are to be explained by some anomaly in the distribution of vagus fibers, or by some happy 'conjunction of circumstances,' which enables the animal to survive the critical period, or, what seems less likely, by an abnormally rapid regeneration or partial regeneration of one of the nerves, must be left undecided.

2. In all dogs (including these exceptional cases) after double vagotomy the ratio, pulse rate to respiratory rate is much increased (before operation, 3:1 to 5:1; after operation, 9:1 to 40:1). If the animals live for more than a few days the ratio tends to diminish somewhat through slowing of the pulse. The rate of respiration,

* 'American Yearbook of Medicine,' 1901, p. 548.

except in the anomalous animals that survive indefinitely, shows remarkable constancy even in dogs which live several weeks. Thus, after double vagotomy, a regulation of the heart rate is again developed which tends to bring it back towards the normal, while in the case of the respiration, such a tendency, if it exists, is much feebler. In the exceptional animals the ratio shows a marked tendency, even in the first few days, to return towards normal, both by a diminution in the pulse rate and by an increase in the rate of respiration.

3. After section of the whole of one vagus and about half of the other, the remaining vagus fibers are sufficient to keep the rate of the heart and respiration almost normal. With how small a proportion of vagus fibers intact, dogs (apart from the anomalous cases mentioned) will survive, remains to be determined, although it has been found that artificial stimulation of a comparatively small number of fibers causes the usual effects on the heart and respiration.

The Influence of the Blood Pressure and of Atropin and Nicotin on Experimental Glycosuria: J. J. R. MacLeod and D. H. Dolley. (Preliminary communication.)

The glycosuria which follows puncture of the floor of the fourth ventricle in rabbits can be inhibited by the administration of nicotine. This may act either by paralyzing the synapses of the centrifugal fibers from the so-called glycosuric center as they pass through the upper thoracic sympathetic ganglia, or be due to a fall in blood pressure.

By applying nicotin directly to these ganglia the glycosuria produced by stimulation of the central end of the vagus is also inhibited, but the marked fall in blood pressure which follows the operation necessary for exposing the ganglia, and not the effect of the drug on the synapses, may be the cause of the inhibition.

In dogs a fall of blood pressure to 40 mm.—produced by hemorrhage—causes the glycosuria produced by stimulation of the central ends of the vagi to disappear.

The injection of nicotin into dogs or rabbits rendered glycosuric by vagal or depressor stimulation does not, as a rule, have any influence in the amount of sugar in the urine.

Atropin has no constant effect either on puncture glycosuria or on that due to stimulation of the vagus or cardiac depressor. Sometimes it causes the amount of sugar in the urine to diminish markedly, at other times it has no effect. No explanation can be offered for this result.

Chas. W. Greene,
Secretary.

SCIENTIFIC BOOKS.

The Phase Rule and Its Applications. By Alex. Findlay. With an Introduction to the Study of Physical Chemistry by William Ramsay. 13 x 18 cm.; pp. lxiv + 313. New York, Longmans, Green and Co. 1904. Price, $1.60.

While physical chemistry in a certain sense is as old as physics or chemistry, the appearance of Ostwald's 'Lehrbuch der allgemeinen Chemie' some twenty years ago really marks the beginning of a new era. Since that time physical chemistry has developed along two quite distinct lines. Van't Hoff brought forward the osmotic pressure theory of solution and Arrhenius the theory of electrolytic dissociation, the two resulting in what may be called the quantitative theory of dilute solutions. Most chemists are fairly familiar with the development of this theory. Not so many people have interested themselves in the second line of work. Roozeboom felt the need of a basis of classification for the numerous double salts and compounds which are met with in inorganic chemistry. He found this in the phase rule of J. Willard Gibbs and he has developed it until it is now seen to be the one possible general basis of classification for all chemical phenomena. Its results are purely qualitative, but they are absolute.

There has been a feeling that there was something antagonistic between the qualitative classification of equilibria and the quantitative study of equilibria. When put in this way, the feeling is seen to be absurd, since the two things supplement each other. It is only by combining the two that we can hope to attain to a quantitative theory of all chemical phenomena.

Mr. Findlay gives a very clear and elementary statement of the phase rule and its applications. The book can be recommended most heartily. There are a few mistakes here and there, but they are not of serious importance. We have here a most satisfactory introduction to the phase rule. It should not be forgotten that the phase rule is valuable in two ways, as a basis of classification and as an instrument of research. It is only the first aspect which has been considered in this volume. This is quite right and proper; but it is as an instrument of research that the phase rule is to come more and more prominently to the front in the next decade. The time has not yet come when a book can be written on this; but such a book will be necessary before very long, and it is to be hoped that Mr. Findlay may see his way clear to writing it.

Wilder D. Bancroft.

CZAPEK'S BIOCHEMIE DER PFLANZEN, VOL. I.

One of the most unsatisfactory chapters on the subject of plant physiology is that relating to the chemical nature of plant substances and the reactions involved in their production and utilization. This situation has been due, not only to the intrinsic difficulties of the problems involved, but also to the unsatisfactory condition of the literature on the subject. While the handbook of Pfeffer has given the latitude and longitude of these problems to the student undertaking a serious study of the chemical aspect of plant physiology, the more detailed account of this phase of the science prepared by Czapek will be a most highly appreciated resource.

The first volume of the work under discussion reveals the scope of the undertaking. The preface indicates that the author has not proposed to write a text-book introducing the beginner to the subject, but rather to prepare a reference work which shall aid the more advanced investigator to use conveniently the work of his predecessors. This object has been most successfully accomplished, and no student of plant physiology can afford to miss this book from his list of immediately available helps.

Czapek's services have not been enumerated, however, when the results of his wide reading and patient summarizing have been recognized, since the work in question is vastly more than a mere compilation. In these days when the democratic spirit of science opens the door of public expression to men of all ranks of scholarship, the task of discriminating accurately the raw from the ripe and the hasty from the well wrought is not always readily accomplished, and a proper sorting of the material at hand by one so well qualified is a genuine service to science.

Then, again, in this eager time when so many men are straining to get the first glimpse of the real solution of fundamental problems, some are bound to guess shrewdly while others are endeavoring to be sure before speaking. To wisely divide this shrewd guess work from the solid fabric is the work of no mere compiler. In this direction, Czapek has rendered good service.

The general chapters introducing the book are all worthy, but of the various subjects treated an especial interest at present attaches to the discussion of the fundamental facts of enzyme action, of the bearing of the theory of ionization on physiological processes and the significance of colloids and the colloidal condition. These subjects are here treated in an illuminating way.

The special part discusses in detail fats, lecithins, physosterin and related compounds, carbohydrates and the bodies forming the cell membranes. On the subjects covered by this volume, the student is given a practically complete citation of the literature appearing prior to June, 1904.

The second volume, the printing of which has been begun, will appear in the near future and conclude this most important contribution of the working student of vegetable physiology. RODNEY H. TRUE.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for May brings this journal up to date. It contains articles on the 'Affinities of the Genus *Equisetum*,' by D. H. Campbell; 'Movements of Diatoms and Other Microscopic Plants,' by D. D. Jackson, and, after a long interval, another of the valuable 'Synopses of North American Invertebrates, XX., Families and Genera of Araneida,' by Nathan Banks; 'Biology of *Acmœa testudinalis* Miller,' M. A. Willcox; 'Habits of the West Indian Whitebait,' A. H. Clark, and notes and reviews.

THE May number (volume 11, number 8) of the *Bulletin of the American Mathematical Society* contains: Report of the February meeting of the San Francisco Section, by G. A. Miller; 'On the development of mathematical analysis and its relation to certain other sciences,' by Emile Picard (St. Louis address), translated by M. W. Haskell; 'On the class of the substitutions of various linear groups,' by L. E. Dickson; 'Note on a problem in mechanics,' by A. M. Hiltebeitel; 'A geometric construction for quaternion products,' by Irving Stringham; Reviews of Lechalas's Géometric générale, by Oswald Veblen; Netto's Elementare Algebra, by J. H. Tanner; Murray's Infinitesimal analysis, by W. B. Fite; Tanner's Elementary algebra, by James Pierpont; Annuaire du Bureau des Longitudes, by E. W. Brown; Gibbs-Roy's Diagrammes et surfaces thermodynamiques, by W. F. Durand; 'Notes'; and 'New Publications.'

SOCIETIES AND ACADEMIES.

THE MICHIGAN ACADEMY OF SCIENCE.

THE annual meeting of the Michigan Academy of Science took place at Ann Arbor, March 30, 31 and April 1. The programs of papers were good, and the meetings well attended by members and others from all parts of the state. On the evening of March 30 the annual address was delivered in University Hall before an audience of two thousand by Professor T. C. Chamberlin, of the University of Chicago, the topic being 'Old and New Hypotheses of the Earth's Origin.' The evening of the thirtieth was spent in a social smoker tendered by the University Research Club; and the excellent address of the retiring president of the academy, Dr. A. C. Lane, state geologist of Michigan, was delivered the afternoon of April 1, the topic being 'Natural Resources, their Conservation and Compensation for Necessary Consumption, one Feature of which is a Scientific Search for Substitutes.'

The academy has had introduced into the state legislature a bill for a topographic survey, and another bill for a natural history survey. The prospect for the passage of these bills seems good, and the academy decided to engage in a vigorous campaign to effect that end.

Papers were read as shown by the following programs:

SECTION OF AGRICULTURE.

Vice-President, W. J. Beal, Agricultural College.

KENYON L. BUTTERFIELD, president of State Agricultural College, Rhode Island: 'Outline of a Course in Rural Sociology.'

W. O. HEDRICK, Agricultural College: 'Syllabus for an Elementary Course in Economics.'

R. S. SHAW, Agricultural College: 'Syllabus for a Four-year Course in Live-stock Husbandry.'

U. P. HEDRICK, Agricultural College: 'Syllabus for a Four-year Course in Horticulture.'

J. L. SNYDER, president of Agricultural College: 'Social Phases of Agricultural Education.'

U. P. HEDRICK, Agricultural College: 'Outline of Topics in Horticulture for some Grades of Common Schools.'

CLARENCE E. HOLMES, superintendent of State School for Blind, Lansing: 'The Place of Agriculture in the Rural Schools.'

F. L. KEELER, Mt. Pleasant: 'School Gardens.'

J. B. DANDENO, Agricultural College: 'Some Experience in the Management of School Gardens.'

ERNEST BURNHAM, Kalamazoo: 'The Preparation of Teachers for the Rural Common Schools.'

C. W. GARFIELD, Grand Rapids: 'The Rural School Museum.'

L. H. BAILEY, dean of Agricultural School, Cornell University: 'Planning Courses for Rural Schools.'

JOSEPH A. JEFFERY, Agricultural College: 'Some Lessons Concerning Soils for the Common Schools.'

SECTION OF BOTANY.

Vice-President, J. B. Dandeno, Agricultural College.

F. C. NEWCOMBE, Ann Arbor: 'Geotropic Response of Stems and Roots at Various Angles of Inclination.'

J. B. DANDENO, Agricultural College: 'Color Stimuli and Plant Functions.'

J. B. POLLOCK, Ann Arbor: 'A Canker of the Yellow Birch accompanied by Nectria.'

F. A. LOEW, Agricultural College: 'A Study of the Effect of Dilute Solutions of Hydrochloric Acid upon the Radicles of Corn Seedlings.'

ELLEN B. BACH, Agricultural College: 'The Toxic Action of Copper Sulphate upon Certain Algæ, in the Presence of Foreign Substances.'

WALTER G. SACKETT, Agricultural College: 'The Relation of Bacteria to Plant Food.'

J. B. POLLOCK and C. H. KAUFFMAN, Ann Arbor: 'Michigan Fungi Not Previously Listed in the Reports of the Michigan Academy of Science.'

R. P. HIBBARD, Ann Arbor: 'Sexual Reproduction in a Red Alga (*Calithamnion Baileyi*).'

W. J. BEAL, Agricultural College: 'Vitality of Seeds after Twenty-five Years.'

J. B. POLLOCK, Ann Arbor: '*Polystictus hirsutus* as a Parasite on Mountain Ash, Maple and Carpinus.'

J. B. POLLOCK, Ann Arbor: 'Note on *Ganoderma* (*Fomes*) *sessile,* Murrill, Its Variation from the Original Description and Possible Parasitism.'

S. O. MAST, Holland: 'A Device for Aerating Aquaria.'

E. N. TRANSEAU, Alma: 'Climatic Centers and Centers of Plant Distribution.'

FRANCES STEARNS, Adrian: 'A Study of Plants in Ravines near Adrian.'

EDITH PETTEE, Detroit: 'Plant Distribution in a Small Bog.'

ALFRED DACHNOWSKI, Ann Arbor: 'Ravines in the Vicinity of Ann Arbor.'

H. S. REED, University of Missouri, Columbia, Mo.: 'History of Ecological Work.'

J. B. POLLOCK, Ann Arbor: 'A Species of *Hormodendrum* Parasitic on the Araucaria.'

S. ALEXANDER, Ann Arbor: 'A Southern Plant, New to the Flora of Michigan, Found Growing at Ann Arbor.'

SECTION OF GEOLOGY AND GEOGRAPHY.

Vice-President, M. S. W. Jefferson, Ypsilanti.

S. ALEXANDER, Ann Arbor: 'A Remarkable Floral Reversion Caused by Bud-Grafting.'

E. L. MOSELEY, Sandusky, O.: 'Changes of Level at the West End of Lake Erie.'

FRANK B. TAYLOR, Fort Wayne, O.: 'Relation of Lake Whittlesey to the Arkona Beaches.'

EDWARD H. KRAUS, Ann Arbor: 'Occurrence and Distribution of Celestite-bearing Rocks.'

W. H. SHERZER, Ypsilanti: 'Glaciers of British Columbia.'

I. C. RUSSELL, Ann Arbor: 'Drumlin Areas in Northern Michigan.'

FRANK LEVERETT, Ann Arbor: 'Interglacial Lake Clays of the Grand Traverse Regions.'

M. S. W. JEFFERSON, Ypsilanti: 'Beach Cusps.'

EDWARD H. KRAUS, Ann Arbor: 'Origin of the Sulphur Deposits at Woolmith Quarry, Monroe Co., Mich.'

SECTION OF SANITARY SCIENCE.

Vice-President, T. B. Cooley, Ann Arbor.

V. C. VAUGHAN, Ann Arbor: 'The War Against Tuberculosis.'

F. G. NOVY, Ann Arbor: 'Bird Hematozoa.'

HENRY B. BAKER, Lansing: 'Am I My Brother's Keeper?'

CRESSY L. WILBUR, Lansing: 'The Scientific Necessity of Complete Registration of Vital Statistics.'

W. G. SACKETT, Agricultural College: 'The Relation of Bacteria to Plant Food.'

S. F. EDWARDS, Ann Arbor: 'Tryptophan Media.'

L. T. CLARK, Agricultural College: 'Technical Cultural Manipulation of Rhizobium.'

H. N. TORREY, Ann Arbor: 'Staining by the Romanowsky Method.'

BRONSON BARLOW, Guelph, Ont.: 'The Steam Still.'

W. R. WRIGHT, Agricultural College: 'The Relation of the Bacterial Content to the Ripening of Michigan Cheese.'

T. B. COOLEY, Ann Arbor: 'Some Bacterial Hemolysins.'

V. C. VAUGHAN, JR., Ann Arbor: 'The Action of the Intra-Cellular Poison of the Colon Bacillus.'

Sybil May Wheeler, Ann Arbor: 'The Extraction of the Intra-Cellular Poison of the Colon Bacillus.'

Mary Wetmore, Agricultural College: 'The Germicidal Action of Fruit Juices upon Certain Pathogenic and Non-Pathogenic Bacteria.'

James C. Cumming, Ann Arbor: 'Disinfection by Means of Formalin and Potassium Permanganate.'

Charles E. Marshall, Agricultural College: 'Bacterial Products in Milk and Their Relation to Germ Growth.'

SECTION OF SCIENCE TEACHING.

Vice-President, W. H. Sherzer, Ypsilanti.

I. B. Meyers, School of Education, University of Chicago: 'Elementary Field Work—Aims and Methods.' Discussion opened by L. H. Bailey, Cornell University.

M. S. W. Jefferson, State Normal College: 'Aims and Methods of Physiographic Field Work in Secondary Schools.' Discussion opened by R. D. Calkins, Central Normal School.

C. E. Adams, University of Michigan: 'Aims and Methods of Zoological Field Work in Secondary Schools.' Discussion opened by Miss Jessie Phelps, State Normal College.

H. C. Cowles, University of Chicago: 'Aims and Methods of Botanical Field Work in Secondary Schools.' Illustrated with lantern. Discussion opened by E. L. Moseley, Sandusky High School, Ohio.

J. Harlan Bretz, Albion College: 'Field Work in Botany for the Winter Season.'

SECTION OF ZOOLOGY.

Vice-President, Raymond Pearl, Ann Arbor.

J. E. Duerden, Ann Arbor: Natural History Notes from the Hawaiian Islands—'Role of Mucus in Corals.' 'Commensalism of Crab and Actinian.'

Hubert Lyman Clark, Olivet College: 'The Value of the Pedicellariæ in the Taxonomy of Sea-urchins.'

L. Murbach, Detroit: 'The Static Function in Some Crustacea.'

Miss Jean Dawson, Ann Arbor: 'An Ecological Study of Physa.'

S. O. Mast, Hope College: 'Light Reactions of Stentor.'

S. J. Holmes, Ann Arbor: 'The Reflex Theory of Phototaxis.'

C. C. Whittaker, Olivet College: 'Variation in the Blue Racer.'

Miss S. A. Ayres, Ann Arbor: 'The Nervous System of *Cœnopsammia*.'

Raymond Pearl and Frances J. Dunbar, Ann Arbor: 'Some Results of a Study of Variation in Paramecium.'

A. B. Clawson, Ann Arbor: 'Some Results of a Study of Correlation in the Crayfish.'

J. E. Duerden, Ann Arbor: 'Demonstration of Hawaiian Corals.'

The University Museum Expedition to Northern Michigan—Charles C. Adams, Ann Arbor: 'Introductory Remarks.' A. G. Ruthven, Ann Arbor: 'An Ecological Survey in the Porcupine Mountains and Isle Royale.' Otto McCreary, Ann Arbor: 'Ecological Distribution of the Birds of the Porcupine Mountains.' Bryant Walker and A. G. Ruthven, Detroit and Ann Arbor: 'Annotated List of the Molluscs of the Porcupine Mountains and Isle Royale.' N. A. Wood, M. M. Peet and O. McCreary, Ann Arbor and Ypsilanti: 'Annotated List of the Birds of the Porcupine Mountains.' N. A. Wood, M. M. Peet and O. McCreary, Ann Arbor and Ypsilanti: 'Annotated List of the Birds of Isle Royale.'

Bryant Walker, Detroit: 'The Distribution of Polygyra in Michigan.'

Frank N. Notestein, Alma College: 'The Ophidia of Michigan.'

Morris Gibbs, Olivet College: 'A Summary of the Work Hitherto done on Michigan Herpetology.'

Hubert Lyman Clark, Olivet College: 'The Distribution of the Blue Racer and Rattlesnake in Michigan.' (With maps.)

Morris Gibbs, H. L. Clark and Frank N. Notestein, Olivet College and Alma College: 'A Provisional List of the Amphibia and Reptilia of Michigan.'

The officers elected for the ensuing year are as follows:

President—W. B. Barrows, Agricultural College.

Vice-Presidents of Sections—Agriculture, Professor W. J. Beal, Agricultural College; botany, Professor J. B. Dandeno, Agricultural College; geography and geology, Mr. Frank Leverett, Ann Arbor; sanitary science, Dr. V. C. Vaughan, Jr., University of Michigan; science teaching, Professor E. N. Transeau, Alma College; zoology, Dr. J. E. Duerden, University of Michigan.

Librarian—Dr. G. P. Burns, University of Michigan.

Secretary-Treasurer—Professor C. E. Marshall, Agricultural College.

F. C. Newcombe.

THE TORREY BOTANICAL CLUB.

A regular meeting was held on April 11, at the American Museum of Natural History, President Rusby in the chair and twenty-two additional members present.

The paper of the evening was on 'Some Edible Seaweeds,' by Professor H. M. Richards.

After reference to the indirect importance of plankton organisms as a source of food for animal life in the sea the speaker referred to those forms of algæ which are used directly by man as foodstuffs. They were grouped roughly under four heads—blue-green, grass-green, brown and red algæ.

In the first group, specimens of a form much prized by the Chinese were shown, which is, according to good authority, *Nostoc commune flagelliforme*. This becomes highly gelatinous when soaked in warm water and is used as a thickening or sauce. A Japanese form, 'Su-zen-ji-nori,' of more doubtful nature, but probably an Aphanothece, was also shown.

Among the grass-green forms mention was made of various species of *Ulva* and *Enteromorpha*, which in dried form go under the name of 'laver' in the British isles and 'ao-nori' among the Japanese.

Among the brown forms only one of the Fucaceæ was mentioned as an article of food, namely *Durvillea utilis*, which is said to be eaten by the natives in certain parts of Chili. The *Laminaria* forms, however, include a large number of edible species. *Alaria esculenta*, common both here and in Europe, was at one time eaten occasionally in the occident. At the present time the Japanese and Chinese make great use of these forms, indeed, after fish, they constitute the chief article of export of the Hokkaido. They are exceedingly plentiful in that region and their collection and preparation for market is a thriving business. In this connection the report of Professor Miyabe and others was passed around and attention was called to the illustrations showing the mode of harvesting the seaweeds. The two most important species seem to be *Laminaria saccharina* (*Laminaria japonica*) and *Ulopteryx pinnatifida* (presumably identical with *Undaria distans* more recently separated by Miyabe and Okamura), which are known under the respective names of 'Kombu' and 'Wakame' by the Japanese. Many other forms are eaten, however.

After reference to the well-known examples 'Irish moss' (*Chondrus crispus*) and 'dulse,' it was said that the two types most used are the delicate *Porphyra* forms and the more massive cartilaginous kinds, such as various *Gigartina*, *Gelidium*, *Gloiopeltis* species. *Porphyra* has also been eaten by Europeans and is said to be used by the natives in parts of Alaska, but it is most highly prized by the Japanese and Chinese. Under the name of 'asakusa-nori' it is put up in neat tin boxes and largely sold in the Tokio markets, it being used by itself or for thickening, giving, as it does, a very glutinous mixture with hot water. 'Fu-nori,' used chiefly as we use starch, is a mixture of species of *Gloiopeltis* and *Endotrichia*, and, like all these forms, is sold dried.

The speaker referred to agar-agar, which, on Wiesner's authority, is said to come from different species in different regions. That of Ceylon is from *Gracilaria lichenoides*, that of Java from *Eucheuma spinosum*, while the Japanese variety is furnished by *Gelidium corneum* and *cartilagineum* and *Gloiopeltis tenax*. Agar, in addition to its uses as a culture medium in bacteriological research, is said to be employed sometimes as an adulterant in the jellies of commerce, where it may be recognized by the siliceous frustules of diatoms, etc., from which it is never free.

Other forms of Florideæ are used as foodstuffs, attention being called to their figures in a Japanese popular work on the useful plants of Japan.

In regard to the food value of algæ it appears that many of them, especially the blue-green forms, contain a very high percentage of proteids, though not much else of value. The gelatinifying substances obtained from the red forms appears to be a substance called gelose, which is similar to, or identical with, the pectic substances so commonly found either deposited in the middle lamella of the cells of higher plants, or in the walls themselves. Mention was incidentally made of the use of seaweeds in the manufacture of iodine and soda-ash. Dr. Rusby exhibited specimens of *Fucus vesiculosus* and an unnamed form, which are used medicinally.

Dr. Howe spoke of dulse as an article of food and of its occurrence in the markets of New York.

After further discussion, adjournment followed.

L. H. Lighthipe,
Secretary pro tem.

THE AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the society was held at Columbia University on Saturday, April 29. On the preceding Saturday the Chicago section met at the University of Chicago. The two sessions of the New York meeting were attended by thirty-eight members. President W. F. Osgood occupied the chair, being relieved by Vice-President E. W. Brown and the secretary. The following new members were admitted: J. H. Grace, Peterhouse, Cambridge, Eng.; H. B. Leonard, University of Chicago; R. B. McClenon, Yale University; W. S. Monroe, Columbia, Mo.; J. C. Morehead, Yale University; Henri Poincaré, University of Paris; R. G. D. Richardson, Yale University; Miss S. F. Richardson, Vassar College; F. R. Sharpe, Cornell University; Miss M. S. Walker, University of Missouri. Six applications for membership were received. The total membership of the society is now 490, including 34 life members.

An appropriation of $100 was made toward binding the rapidly accumulating library material. The catalogue of the library now includes nearly 2,000 volumes, accessions amounting to some 500 volumes per annum. The greater part of the expense of binding is borne by the Columbia University Library, in which the collection is deposited.

The society has recently issued, through The Macmillan Company, an octavo volume of 175 pages containing the lectures on mathematics delivered at the Boston colloquium, September, 1903, by Professors E. B. Van Vleck, H. S. White and F. S. Woods.

The following papers were read at the April meeting:

Arthur Schultze: 'Graphic solution of quadratics, cubics and biquadratics.'

Max Mason: 'On the derivation of the differential equation of the calculus of variations.'

D. R. Curtiss: 'Theorems converse to Riemann's on linear differential equations.'

Virginia Ragsdale: 'On the arrangement of the real branches of plane algebraic curves.'

J. C. Morehead: 'Numbers of the form $2^kq + 1$ and Fermat's numbers.'

E. B. Van Vleck: 'Supplementary note on theorems of pointwise discontinuous functions.'

James Pierpont: 'Inversion of double infinite integrals.'

James Pierpont: Multiple integrals (second paper.'

R. B. McClenon: 'On simple integrals with variable limits.'

E. O. Lovett: 'On a problem including that of several bodies and admitting of an additional integral.'

M. B. Porter: 'Concerning Green's theorem and the Cauchy-Riemann differential equations.'

M. B. Porter: 'Concerning series of analytic functions.'

J. E. Wright: 'Differential invariants of space.'

Edward Kasner: 'On the trajectories produced by central forces.'

E. B. Wilson: 'Sur le groupe qui laisse invariant l'aire gauche.'

E. J. Wilczynski: 'Projective differential geometry.'

I. M. Schottenfels: 'On the simple groups of order $8!/2$' (preliminary communication).

I. M. Schottenfels: 'Certain trigonometric formulas for the quantity $x + \epsilon y$, where $\epsilon^2 = 0$.'

Edward Kasner: 'A theorem concerning partial derivatives of the second order, with applications.'

J. E. Wright: 'On differential invariants.'

L. P. Eisenhart: 'Surfaces of constant curvature and their transformations.'

L. E. Dickson: 'On the class of the substitutions of various linear groups.'

Josiah Royce: 'The fundamental relations of logical and geometrical theory.'

The summer meeting of the society will be held at Williams College, Williamstown, Mass., on Thursday and Friday, September 7–8. The San Francisco section will also meet in September.

F. N. Cole,
Secretary.

DISCUSSION AND CORRESPONDENCE.

MARINE ZOOLOGY IN THE HAWAIIAN ISLANDS.

TO THE EDITOR OF SCIENCE: At a time when zoologists are making their plans for summer vacation work it seems opportune to direct attention to the advantages offered even in such a distant territory as the Hawaiian Islands. During a visit to the islands last year, under the auspices of the Carnegie Institution, for the purpose of studying the living corals, I was afforded the privileges of the public aquarium recently established near Honolulu, and the directors of the institution desire it to be known that they will be prepared to accord a similar courtesy to other zoologists visiting the islands for purposes of research.

The aquarium is a modest structure, erected a little over a year ago, and is under the control of the Rapid Transit Company, though the funds were largely provided by the generosity of different gentlemen interested in the welfare of the islands. It is most advantageously situated at Waikiki Beach, a suburb of Honolulu, and the adjacent coral flats constitute most favorable collecting ground. Though no special appliances beyond exhibition and experimental tanks are available, yet the advantages of these and a constant supply of sea-water appeal to any student desirous of carrying out investigations on living forms. Moreover, with a generosity which is very praiseworthy, the directors are prepared to make whatever reasonable adaptations may be required.

Our knowledge of the marine fauna of the Hawaiian Islands is becoming rapidly extended, mainly through the reports on the collections made by the U. S. Fishery Bureau, under the direction of President D. S. Jordan, during the two successive seasons, 1901 and 1902. The large addition to the number of species of fishes alone shows how very desirable was such faunistic work, and other groups are yielding a corresponding number of new forms. The physical conditions of the coral reefs have been studied in part by Professor A. Agassiz. Though the luxuriance of the life on the reefs does not equal that in the more distant Tahiti, Samoa, or the Philippine Islands, yet there is sufficient, particularly in such places as Kaneohe Bay, to satisfy the most ardent investigator.

For the student of terrestrial forms the islands are particularly interesting on account of the influence of introduced animals and plants upon an indigenous fauna and flora. Representatives from the east and from the west, from temperate and from tropical regions, here flourish, and against the pests a strong corps of entomologists is engaged in further introduction of possible remedial forms. The fact that the land shells of the islands served to supply the Rev. J. T. Gulick with material for the theory of isolation adds an interest to the evolutionary biologist. The ethnology and various departments of natural history are well cared for by Professor T. H. Brigham, of the Bishop Museum, and his staff of assistants.

As a last word of attraction regarding the situation of the aquarium one may quote from the 'Report on Collections of Fishes made in the Hawaiian Islands' by Professor O. P. Jenkins:

> Of all situations about the island of Oahu, the submerged reef which extends from the entrance of the harbor of Honolulu to some distance past Waikiki furnishes the most prolific supply of fishes, both as to number of species and amount of the catch. This reef at low water is from a few inches to a few feet under water and extends from one mile to two or three miles from the shore, where the water abruptly reaches great depths. Over the surface and along the bluff of this reef may be found representatives of most of the shore fauna of the Hawaiian Islands. This reef, so favorably situated, so accessible, and so rich in material, can not fail to be of increasing interest to naturalists who may have the good fortune to devote themselves to the study of its wonderful life.

J. E. DUERDEN.
RHODES UNIVERSITY COLLEGE,
GRAHAMSTOWN, CAPE COLONY.

THE GREENE EXPLORING EXPEDITION.

TO THE EDITOR OF SCIENCE: The W. C. Greene Exploring Expedition consisting of Robert T. Hill, John Seward, Frank H.

Fayant and E. O. Hovey has finished its first exploration of the northern part of the Western Sierra Madre Mountains of Mexico. A summary account of the first half of the trip, from El Paso to Guaynopita, has been given to the readers of SCIENCE. The second half of the journey was no less interesting than the first and was fully as productive of scientific observations.

Leaving Guaynopita by pack train on March 11, the first stage of the journey was the climb of 3,500 feet out of the Yaqui (Aros) cañon in which Guaynopita is located on to the great mesa out of which the mountains of the region have for the greater part been carved. The contrast in vegetation between different parts of this section may be illustrated by the statement that fan-leaf palms flourish in the gorges near the river, while on the high mesa one finds the great long-leaf sugar pine predominant.

Our course lay southward for sixty or seventy miles along the broad plains and narrow divides forming the mesa, or connecting different parts of it, and we had abundant opportunity of studying the topography of the great Tutuaca Cañon, which is tributary to the Yaqui (Aros), and of observing the contest for the drainage of the plateau between the streams flowing to the west and those flowing to the east. The dissection of the plateau is more pronounced toward the west, and our cross-section of the cañon of the Tutuaca River from its eastern boundary at the edge of the Mesa Venado disclosed acid and basic lavas, tuffs, agglomerates and conglomerates through six thousand feet of beds. The western rim of the Tutuaca Cañon is near the important Dolores mineral district. Some of the extensive igneous action has been accompanied and followed by strong mineralization of veins. At Dolores a fifteen-stamp mill of the most up-to-date construction is just being completed under the supervision of Manager J. Gordon Hardy for the treatment of the rich gold and silver ores of the Alma Maria vein by the direct cyanide process.

Near Dolores we turned southward again and pursued our course along a series of high mesas, divides, arroyos and river channels until we reached the little Indian town of Yepachic. In this part of our route we passed through three or four fertile ranches and at Yepachic found the people (Tarahumares and Pimas) living for the most part from the tillage of a small alluvial plain surrounded by low mountains. Here we turned westward again and within a few miles reached the Cerro Boludo (Bald Mountain) district, which, like several others on our route, is characterized by a mineralized quartz vein twenty to eighty feet wide which can be seen traversing hill and vale for miles.

Six or eight miles south of Cerro Boludo lies the little Mexican camp of San Francisco, where a diminutive two-stamp mill feeds a primitive arrastra as a preliminary to pan amalgamation of the gold. Thence the Ocampo trail leads over a divide and across the deep cañon of the Rio de Mayo, down into and out of the Rosario arroyo before the great arroyo is reached in the bottom of which, at the junction of two branch arroyos, is crowded the mining camp of Ocampo—a place better known by its old name of Jesus Maria. This is the site of many rich gold and silver mines, the most famous of which is the Santa Juliana.

From Ocampo to Miñaca, 100 miles, the trail crosses the high mesa, which has a gentle slope eastward and is partly dissected by comparatively shallow cañons of varying depths. Miñaca, the present terminus of the Chihuahua and Pacific Railway, is in a beautiful broad basin about 7,000 feet above tide, which is traversed by the headwaters of the Rio Verde, a tributary of the Yaqui (Aros) River.

At Miñaca our party took train for Chihuahua and thence went by rail to El Paso, completing our noteworthy circuit in the western Sierra Madre Mountains of northwestern Mexico. The circuit was not very long, compared with the mileage of some expeditions, but the results along lines of physiographic, dynamic and economic geology are of importance and will be published as soon as they can be put into proper shape, while the photographs taken illustrate as completely as practicable the phenomena observed. Among others the problems of buried mountains, bolsen deserts, mesas and the structure of the western Sierra Madres have had much new light thrown upon them, if they have not been solved.

EDMUND OTIS HOVEY.

NEWSPAPER SCIENCE.

To the Editor of Science: In the interest of the dignity of scientific research I wish to repeat the statement, made by me on a former occasion, that I have not authorized the sensational reports concerning any work; and that I am in no way responsible for the idiosyncrasies of our daily press.

JACQUES LOEB.

BERKELEY,
May 27, 1905.

A BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE.

The undersigned is compiling a 'Biographical Directory of American Men of Science.' It was begun as a manuscript reference list for the Carnegie Institution of Washington, but arrangements have now been made for its publication. The book should be ready in the autumn, nearly 4,000 biographical sketches being in type. The proofs have been corrected by those concerned, but in order to secure as great accuracy as possible a revised proof will be sent in the early autumn.

This letter is written with a view to securing biographical sketches from those living in North America who have carried on research work in the natural or exact sciences but who have not received proof of a sketch for correction. Some of those who were asked to send the information required did not reply even in answer to a second and third request, and there are, of course, many who should be included in the work but who for one reason or another did not receive the request for information.

It is intended that each biographical sketch shall contain information, as follows:

1. The full name with title and mail address, the part of the name ordinarily omitted in correspondence being in parentheses.
2. The department of investigation given in italics.
3. The place and date of birth.
4. Education and degrees with dates.
5. Positions with dates, the present position being given in italics.
6. Temporary and minor positions.
7. Honorary degrees and other scientific honors.
8. Membership in scientific and learned societies.
9. Chief subjects of research, those accomplished being separated by a dash from those in progress.

The undersigned will be under great obligations to those men of science who will send him biographical sketches of themselves or who will secure sketches from those who should be included in the work—those who live in the United States, Canada, Newfoundland, Mexico or Cuba, and who have contributed to the advancement of one of the following sciences: mathematics, astronomy, physics, chemistry, geology, botany, zoology, pathology, physiology, anatomy, anthropology, psychology.

The compiler of the book hopes that any assistance given him to make it as complete and accurate as possible will be at the same time a contribution to the organization of science in America.

J. MCKEEN CATTELL.

GARRISON-ON-HUDSON, N. Y.

SPECIAL ARTICLES.

THE NOMENCLATURE OF TYPES IN NATURAL HISTORY.

Practical work in the arrangement and cataloguing of 'types' and other museum material has shown us that the present nomenclature is not yet sufficient for critically distinguishing all the different classes of such specimens. Further, some of the terms which have been proposed for the purpose are already employed in other ways: for instance, *homotype* is in use in biology; *monotype* is the name of a printing machine; *autotype* is the term for a printing process. We wish, therefore, to submit the following system of nomenclature; and we hope that, in making it more complete, we have provided a scheme which will render efficient service in the labeling and registration of types and typical material.

The terms printed in broad-faced letters are the additions or modifications for which we are at present responsible. A fuller explanation of all the terms will be found in the 'Catalogue of the Type and Figured Specimens of Invertebrate Fossils in the U. S. National Museum,' a work which has been prepared by Charles Schuchert and is now passing through the press; and the present article gives a synopsis of the terms which it has been found necessary to use in connection with that and similar work.

We now make another suggestion. After the different terms we have placed, in brackets, the contractions which we propose should be used in the actual marking of small specimens to which it is impossible or inadvisable to affix the full label. Our plan for such contractions is this: For types of the first class, two capital letters; for those of the second class, one capital and one small letter; for typical specimens, two small letters.

In the definitions which follow, the term 'description' indicates either a description by words, or by a picture, or by both combined. For the sake of accuracy we suggest that the original description by words (type-description) be called the **protolog**, the original description by a picture (type-figure), the **protograph.** It is obviously more easy to identify actual types from the latter than from the former.

Primary types **Proterotypes.** Material upon which original descriptions of species are based.

Holotype [**H. T.**]. The only specimen possessed by the nomenclator at the time; the one specimen definitely selected or indicated by the nomenclator as the type; the one specimen which is the basis for a given or cited protograph.

Cotype (more properly *Syntype*) [**S. T.**]. A specimen of the original series, when there is no holotype.

Paratype [**P. T.**]. A specimen of the original series, when there is a holotype.

Lectotype [**L. T.**]. A cotype chosen, subsequently to the original description, to take the place which in other cases a holotype occupies (λεκτός, chosen, picked).

Supplementary types (**Apotypes** vice *Hypotype* in use). Material upon which supplementary descriptions of species are based.

Heautotype (vice *Autotype* in use) [**H. t.**]. Any specimen identified with an already described and named species, selected by the nomenclator himself in illustration of his species, such specimen not being identifiable as one of the proterotypes.

Plesiotype [**P. t.**] Any specimen identified with an already described and named species, but not selected by the nomenclator himself.

Neotype [**N. t.**]. A specimen identified with an already described and named species, selected to be the standard of reference in cases when the proterotypes are lost, destroyed or too imperfect for determination, such specimen being from the same locality and horizon as the holotype or lectotype of the original species.

Typical specimens (**Icotypes**) (εἰκός, what is like).* Material which has not been used in literature, but serves a purpose in identification.

Topotype [**t. t.**]. A specimen of a named species from the locality of the holotype or lectotype, in paleontology from the same locality and horizon.

Metatype [**m. t.**]. A topotype identified by the nomenclator himself.

Idiotype [**i. t.**]. A specimen identified by the nomenclator himself, but not a topotype.

Homoeotype (vice *Homotype*, preoccupied) [**h. t.**]. A specimen identified by a specialist after comparison with the holotype or lectotype (ὅμοιος, resembling).

Chirotype [**x. t.**]. A specimen upon which a chironym is based (chironym, a Ms. name, Coues, 1884).

In addition to the above, we have the use of the word 'type' in connection with genera—a given species is the type of the genus. The classification of such types is as follows:

TYPES OF GENERA (*Genotypes*).

Genoholotype. The one species on which a genus is founded; or a series of species on

* εἰκός, gen. εἰκότος, εικο for εικοτο, to make. Ico type for euphony.

which a genus is founded, the one species stated by the author to be the 'type.'

Genosyntype. One of a series of species upon which a genus is founded, no one species being the genoholotype.

Genolectotype. The one species subsequently selected out of genosyntypes to become the 'type.'

CHARLES SCHUCHERT,
S. S. BUCKMAN.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SUMMER MEETING OF SECTION E.

SECTION E of the American Association for the Advancement of Science will hold a summer meeting at Syracuse, N. Y., July 19–22. Arrangements have been made for making the meeting enjoyable and profitable to all members of the section. The vicinity of Syracuse is one of great interest in several branches of geology: the fossiliferous rocks of the New York series are well exposed in many ravines; the surface shows most of the phenomena of chief interest in glacial geology; the preglacial and the modern topography have been worked out by specialists, and the economic geology of the district is important. The chief study in the field during the meeting will be the gorges and lakes of the glacial drainage, which are the most novel features of the district.

In making its plans for the meeting the sectional committee has accepted the cordial invitation of the committee having in charge the joint summer courses in geology for several eastern universities and colleges to hold a meeting in conjunction with the summer school.

The following program may now be provisionally announced:

Wednesday, July 19, 8.00 P.M.—The section will meet informally for the purpose of organization and of listening to short addresses by the officers of the section, the state geologist and others. Professor T. C. Hopkins, of Syracuse University, will discuss local geology.

Thursday, July 20.—Field day with picnic lunch. The section will visit the Jamesville Lakes, the 'fossil cataracts' and the several glacial stream channels in the vicinity of Jamesville and part of the shore line of Lake Iroquois in Onondaga Valley. Field addresses will be given by Professor H. L. Fairchild on 'The Local Glacial Features' and by Professor John M. Clarke on 'The New York Series, with Special Reference to the Paleontology and Stratigraphy of the Syracuse district.'

8.00 P.M.—Popular illustrated lecture by Professor H. L. Fairchild on 'Glaciation in North America with Particular Reference to the Effects of the Ice Sheet in Central New York.'

9.30 P.M.—Social meeting in the rooms of the University Club.

Friday, July 21.—Field day with picnic lunch. The party will go by trolley to Fayetteville and thence on foot to the glacial channels and lakes south and west of Fayetteville. Field address by Mr. Frank B. Taylor, 'The Great Lakes in Their Relation to Local Geology.'

8.00 P.M.—Business meeting of the section for the reading and discussion of papers.

Saturday, July 22.—To Fayetteville by trolley or by boat on the Erie Canal. Visit the Fayetteville Channel, Round and White Lakes, the Mycenæ and adjacent channel northeast of Fayetteville, Salina Shales, Manlius limestone, Helderberg limestone, Oriskany sandstone and Onondaga limestone outcrops. Field address by Professor A. W. Grabau on 'The Physical Characters and History of Some New York Foundations.'

Free discussions of all papers will be invited.

Further particulars regarding the meeting may be obtained by addressing Professor T. C. Hopkins, University, Syracuse, N. Y., or the undersigned.

EDMUND OTIS HOVEY,
Secretary Section E,
Am. Assoc. Adv. Sci.

AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK CITY,
May 23, 1905.

PRIZE FOR A METHOD OF SETTING DIAMONDS FOR CUTTING.

CONSIDERING the fact that the setting and resetting of diamonds for cutting purposes involves the use of an alloy, consisting of tin and lead, the handling of which has been ascertained to produce injurious effects, *i. e.*, lead-poisoning, the government of the Netherlands has decided to open a competition under the following conditions.

The government desires a medium for the setting and resetting of diamonds to be cut —which needs not necessarily be an alloy— the use of which can not produce effects detrimental to the health of those handling the same, or an elaborate project of altering the method now in use, in such a manner that no such injurious effects can be produced.

The following requirements have further to be fulfilled:

1. The medium or the method must be practicable for all sizes and shapes of diamonds in the following branches of the diamond industry, viz., brilliants, roses and so-called non-recoupés, now being cut in the Netherlands.

2. The application must be such as to be learned by the workmen, used to the present method of work, without any great difficulty, while the setting and resetting must not require more time, or considerably more time than is usual now.

3. The application and use must not entail considerable pecuniary outlay.

The Minister of the Interior has appointed a committee of experts to consider the answers submitted, and to award the prize. The answers must be written in either the Dutch, French, English or German languages, and must be accompanied by samples or objects to enable the committee to form an opinion about the practical value of the invention, as also of a legibly written address of the competitor.

The answers, and the samples or objects pertaining thereto, must be sent carriage paid, and if sent from foreign countries duty paid, before January 1, 1906, to Professor Dr. L. Aronstein, chairman of the committee, Chemical Laboratory of the Polytechnic School, Delft, Holland.

The prize to be awarded for a complete solution of the problem is six thousand florins. The committee is empowered to divide the prize among different competitors, or to partially award the prize in case of a partial solution of the problem, for instance if it is applicable to one of the above-named branches of the diamond industry. The committee is also empowered to prescribe certain conditions, to be fulfilled by the competitor, before awarding the prize.

SCIENTIFIC NOTES AND NEWS.

At the annual anniversary meeting of the Royal Geographical Society, on May 22, Sir Clements Markham resigned the presidency of the society which he has held during the past twelve years. Sir George Goldie, founder of Nigeria, was elected to the presidency, Sir Clements Markham and Colonel D. A. Johnston were elected vice-presidents.

Dr. Henry S. Pritchett, president of the Massachusetts Institute of Technology, will give the commencement address at the University of Michigan, on June 22.

Dr. Lewellys F. Barker, who is giving up the headship of the department of anatomy at the University of Chicago to accept the chair of medicine at the Johns Hopkins University, was given a dinner by his colleagues at the University of Chicago, on May 27.

M. Sébillot has succeeded M. Deniker as president of the Anthropological Society of Paris.

Lafayette College will confer the degree of Doctor of Laws on Professor Henry M. Howe, of Columbia University.

Dr. William James, professor of philosophy at Harvard University, will give a course of lectures at the University of Chicago during the summer session.

Major E. C. Carter, U. S. A., commissioner of public health for the Philippines, has been relieved and will return to Washington. Dr. Victor G. Heiser, of the U. S. Public Health and Marine Hospital Service, has been appointed commissioner of public health.

Mr. H. E. Barnhard, state chemist of New Hampshire, has been selected as the chemist for the new Indiana Laboratory of Hygiene at Indianapolis, provided for by the last legislature.

PROFESSOR RUDOLF HAUTHAL, of the Natural History Museum at La Plata, has been appointed director of the Museum at Hildesheim.

DR. W. B. WHERRY has resigned his position as bacteriologist at the Government Laboratories, at Manila, and has returned to his former position with the Rush Medical College at Chicago.

PROFESSOR OMORI, the Japanese authority on earthquakes, is going to India to make an examination of the scenes of the late Indian earthquake, more especially in the Kangra Valley.

MR. O. M. LELAND, department of civil engineering of Cornell University, will have charge of part of the field work connected with the survey about to be made to determine the boundary line between Alaska and British Columbia.

DR. LEWIS E. JEWELL, of the Johns Hopkins University, will be one of a party to observe the solar eclipse from North Africa.

DR. HUGO MÜNSTERBERG, professor of psychology at Harvard University, sailed for Germany on June 1.

DR. L. O. HOWARD, chief of the Division of Entomology, U. S. Department of Agriculture, and permanent secretary of the American Association for the Advancement of Science, sailed on June 3 for Europe. He goes first to Italy and then to Germany, his object being, more particularly, to secure information in regard to the parasites that feed on the gypsy moth and the brown-tail moth.

PROFESSOR B. M. DUGGAR, of the University of Missouri, sailed for Europe on May 20. He will attend the International Congress of Botanists at Vienna, and will spend the coming year in work at various botanical laboratories on the continent. During his absence the department of botany will be in charge of Mr. Howard S. Reed. Mr. H. L. Shantz, of the University of Nebraska, has been added to the instructing force for the coming year.

DR. IRA N. HOLLIS, professor of engineering at Harvard University, will spend next year in Geneva.

DR. A. P. BRIGHAM, professor of geology and natural history at Colgate University, will spend the summer in Europe, sailing on June 14.

PRESIDENT TAYLOR, of Vassar College, will spend next year abroad.

AT the meeting of the Paris Academy of Sciences, on May 22, M. Maquenne read an obituary notice of the late M. Duclaux.

THERE will be a civil service examination, on June 28, for the position of plant pathologist at $1,600 per annum in the Bureau of Plant Industry, Department of Agriculture.

THE board of estimate of New York City has appropriated $850,000 to begin the erection of the New Bellevue Hospital, the cost of which will be $8,500,000.

THE Food Standards Committee of the Association of Official Agricultural Chemists has been this week in session at the Great Northern Hotel, Chicago, to give final consideration to the standards for edible oils and flavoring extracts. The following members were present: Wm. Frear, of State College, Pa.; Henry A. Weber, Columbus, Ohio; Melvill A. Scovell, Lexington, Ky.; Edward H. Jenkins, New Haven, Conn.; and Harvey W. Wiley, of Washington, D. C. Before returning to Washington, Dr. Wiley will deliver the commencement address at the Oklahoma Agricultural Experiment Station at Stillwater, the subject being 'Success.'

THE International Institute of Sociology, established at Paris, of which Professor Gustav Schmoller, of Berlin, is the president, has accepted an invitation of the Sociological Society, supported by the University of London, to hold its next congress in London in July, 1906.

THE India correspondent of the *Lancet* writes: "The plague epidemic continues with unabated virulence. For the week ending April 22 54,602 deaths were recorded, as compared with 51,786 for the preceding seven days. The death-roll for 1905 promises to exceed all former records. In 1901 the total deaths from plague were returned at 273,679, in 1902 the number rose to 577,427, in 1903 it reached 851,263 and in 1904 it was 1,022,299. From January 1 of the present year up to April 15 the number of fatal cases is reported at 576,366, and it is very doubtful whether these figures tell the whole truth. Of the total of 64,214 seizures with 54,602 deaths during the week ending April 22 the Bombay presidency had 3,497 cases and 2,787 deaths; Madras, 65 cases and 65 deaths; Bengal, 4,993 cases and 4,351 deaths; the United Provinces, 18,249 cases and 16,637 deaths; the Punjab, 33,162 cases and 27,362 deaths; Burma, 183 cases and 175 deaths; the Central Provinces, 223 cases and 175 deaths; Mysore state, 50 cases and 40 deaths; Haidarabad state, 401 cases and 316 deaths; Central India, 117 cases and 84 deaths; Rajputana, 2,924 cases and 2,406 deaths, and Kashmir, 359 cases with 215 deaths. These detailed figures will show how the disease has extended over the country and the heavy mortality of the cases. The mortality is higher this week in the Punjab by 3,420, in the United Provinces by 753, in Rajputana by 200, in Burma by 20, in Kashmir by 28, in Bombay city by 132 and in Calcutta by 130. The only noticeable decrease is in the districts of Bengal, where the epidemic seems to be abating. In this area, however, the outbreak occurred earlier in the season. During the present outbreak the anti-plague serum from the Pasteur Institute in Paris has been somewhat extensively used for the treatment of cases both in Bombay and Calcutta, and, although it is early to form a definite opinion, numerous individual reports would seem to show its value.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Percival Lowell has established a liberally endowed fellowship, to be known as The Lawrence Fellowship, for the Department of Astronomy at Indiana University. By the terms of the endowment the fellow is appointed by the department, but the appointment is subject to the approval of the founder. A Lawrence fellow shall be given an opportunity for astronomical research at the Lowell Observatory and to prepare a thesis on some astronomical subject agreeable to the director and the fellow. Mr. John C. Duncan has received the appointment for the year 1905–6.

Dr. W. W. Keen, professor of surgery at Jefferson Medical College, has presented to that institution $5,000 to found as a memorial to his wife the Corinna Borden Keen Research Fellowship. The conditions of the fellowship are that whenever there is accumulated from the income the sum of $500 it shall be awarded to a graduate of the college.

Miami University has been offered $40,000 by Mr. Carnegie for a library building on condition that a similar sum be raised for its maintenance. It is expected that work will begin at once. The addition to Brice Scientific Hall and the woman's dormitory, Hepburn Hall, will be ready for use by the students of the summer session.

Mr. J. P. Branch, of Richmond, Va., has given $30,000 to Randolph-Macon College for a dormitory.

Colgate University has begun the erection of a Science Hall to contain the departments of geology and geography, biology and physics and the museum collections. It will be built of stone at a cost of about $90,000, the dimensions being 117 x 70 feet. It will be ready for use during 1906.

At the University of Colorado 86 degrees were conferred at the commencement exercises on June 7. The number receiving the various degrees was as follows: M.A., 9; M.S., 2; B.A., 40; B. S. (engineering), 14; M.D., 6; LL.B., 15.

John Pearce Mitchell, A.B. (Stanford), who is now studying in Berlin, has been appointed assistant in chemistry at Stanford University.

At Barnard College, Columbia University, Miss Margaret A. Reed has been appointed lecturer in zoology, and Miss Marion E. Latham, assistant in botany.

Mr. Ernest Brown, lecturer in applied mechanics in the University of Liverpool, has been appointed assistant professor in this subject at McGill University. Dr. J. W. Hickson has been appointed assistant professor of psychology and lecturer in philosophy.

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FRIDAY, JUNE 16, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*THE RELATIONS OF PUBLIC HEALTH SCIENCE TO OTHER SCIENCES.**

"PHYSICAL science is one and indivisible. Although for practical purposes it is convenient to mark it out into the primary regions of physics, chemistry and biology, and to subdivide these into subordinate provinces, yet the method of investigation and the ultimate object of the physical inquirer are everywhere the same."—Huxley.

Physical science is one and indivisible; that, as I understand it, is the key note of this great congress, of which public health science forms one section, and as I am invited to consider, in the brief space of forty-five minutes, the relations of public health science to other sciences, I shall take the liberty of selecting from the whole number of 'other sciences' only a few, the relations of which to public health science seem to me for one reason or another especially important at the present time. I accept the term public health science without hesitation, for any division of human knowledge which has worked out its own laws with strict adherence to the rules of inductive and deductive reasoning, as public health science has done, and which has reached results enabling it to predict with accuracy, as public health science can now predict, is entitled to a place and an honorable place among the physical sciences.

Public health science had its rise and a considerable development in the eighteenth century. Before that time numerous procedures tending to protect or promote the public health had, indeed, at one time or

* Address before the International Congress of Arts and Science, St. Louis Exposition.

another existed, but these were largely empirical and quite as often directed to the convenience of mankind as to their sanitary safety. In this class belong the Mosaic code; the water supply introduced into Jerusalem by Hezekiah; the sanitary engineering of Empedocles; the *Cloaca maxima;* the water supplies of ancient Mycenæ and of Rome, and all the earlier, and too often futile, forms of quarantine. Even the art of inoculation for smallpox was only an ingenious knack introduced from the east, where it had been long used empirically, and although it was a public health measure now of the utmost interest and capable at the time of great practical service, it had until recently no scientific basis, but belonged in nearly the same class as the amulets and charms, the prayers and incantations, of the superstitious.

It was not until the middle of the eighteenth century, namely, in 1767, that Sir George Baker, by the use of the methods of pure inductive reasoning, made the first scientific discovery in public health science in the subdivision of epidemiology, namely, that the epidemic colic of Devonshire, England, was due to an obscure poisoning by lead conveyed through the common cider used for drinking in that district. In 1774 the foundations of state hygiene and sanitation were laid in consequence of the patient investigations and startling revelations of John Howard, by an act of Parliament providing for the sanitation of jails and prisons. The beginnings of marine hygiene and sanitation appear in 1776, when Captain Cook, the navigator, was awarded the Copley medal of the Royal Society for his remarkable success in protecting the lives of his sailors on his second voyage. In 1796 Edward Jenner, working also in a strictly scientific manner, and employing the methods of rigid inductive research, laid securely for all time the foundations of personal hygiene and immunization, by showing how we can produce at will such modifications of the physiological resistance or susceptibility of the human body as to make it immune to smallpox.

The importance of these fundamental and splendid discoveries, not only to the public health of the time, but far more to the development of public health science in all the centuries to come, is incalculable. Reduced to their lowest terms, we have in these eighteenth century discoveries the germs of some of the most important divisions of public health science as it is to-day, namely, (1) *epidemiology,* (2) *sanitation of the environment,* and (3) *immunization of the human mechanism,* this last the most marvelous phenomenon hitherto discovered in personal hygiene.

Time fails me to do more than name some of the principal steps in the advancement of public health science in the nineteenth century. We have, for example, in 1802, the beginnings of factory hygiene and sanitation; in 1829, the first municipal water filter, one acre in area, constructed for the Chelsea Company of London; in 1834, recognition of the important relation of poverty to public health, in the famous report of the Poor Law Commissioners of that year; in 1839, the beginnings of registration and accurate vital statistics; in 1842, an important report on the sanitary condition of the laboring population of England; and in 1843, a similar report on the health of towns; in 1854, for the first time clearly taught, the lesson, even yet not properly taken to heart, that drinking water may be the ready vehicle of a terrible epidemic of cholera. About 1860, striking epidemics of trichinosis first came into public notice, and here, also, belongs the magnificent work of Pasteur, while in 1868, Lister, following in the footsteps of

Pasteur, revealed to the world the basis of true cleanliness in asepsis, and in 1876, bacteriology became firmly established as a science by Koch's studies on anthrax. The decade from 1880 to 1890 may be called the golden age of ætiology, for in these years were discovered the hitherto unknown parasitic microbes of typhoid fever, tuberculosis, malaria, Asiatic cholera, diphtheria and tetanus. The last decade of a century which has well been called 'the wonderful,' witnessed the discovery of antitoxins by Behring and the beginnings of serum therapy. The list is long, and I have not mentioned nearly all of the discoveries of capital importance, but because of these and their fruits, I am in the habit of saying to my students that with the single exception of the changes effected by the acceptance of the theory of organic evolution, there has been no modification of human opinion within the nineteenth century more wonderful, or more profoundly affecting the general conduct of human life, than that in our attitude toward the nature, the causation and the prevention of disease—that is to say, toward public health science.

No mere outline like this of the history of public health science can possibly serve to show how, like other applied sciences, this one has not grown as a branch grows from a tree, namely, from a large stem or stock of knowledge, tapering out into thin air, and with its latest growth its least and weakest. That common simile in which the various divisions of science are represented as branches of the tree of knowledge, is a grotesque survival of a time when neither trees nor science were understood. No simile is perfect or even approximately correct, but one better than the tree and its branches for the origin and relationships of any inductive science is that of a river, rising from various and often obscure sources, growing in size and importance as it proceeds both from the springs within its own bed and by the entrance and contributions of tributary streams, and finally pouring its substance into the mighty ocean of accumulated human knowledge.

Up to the time of the establishment of the registration of vital statistics in England, in 1839, the stream of public health science, although full of promise, was only a slender thread, but when the results of registration were fully enlisted in its service it visibly widened and deepened. Epidemiology, as has been said, had the honor of giving birth to the science in 1767, and it added to its offspring a rich endowment when, in 1854, Dr. John Snow proved that the water of the Broad Street well in London had caused an epidemic, in which more than six hundred persons died of Asiatic cholera. The stream of public health science was still further enlarged and quickened by the revelation in and after the sixties of the simple causes of numerous epidemics of trichinosis and of typhoid fever, the latter sometimes through milk. There was an extraordinary popular awakening in England to the importance of sanitation and public health measures in the middle of the nineteenth century, but we look for some time in vain for any marked inosculation between public health science and other sciences, such as physics, chemistry, microscopy, bacteriology, climatology, engineering or education. We have, to be sure, minor contributions from the microscopists, such, for example, as that from Dr. Hassall, who, in 1850, made a careful microscopical examination of the water supply of London and showed the presence in the public drinking water of muscle fibers, intestinal parasites and other materials, plainly derived from sewage; but it was not until Pettenkofer and his disciples, in Germany, and Angus Smith and others, in England, began their splendid chemical investigation that the tributary stream of *sanitary chemistry* enlarged materially that of public health science. In saying this I do not forget that my late friend and colleague, William Ripley Nichols, whose solid contributions to sanitary chemistry were among the first in America, and will always remain among the best anywhere, long ago pointed out that, as early as 1789,

Fourcroy studied the nature of 'litharged' wine, Berthollet (1801) the methods of preserving water for long voyages, Chevreul (1846) various chemical reactions which explain the hygiene of populous cities, and (1856, 1862, 1870) methods of preparing and preserving food; Graham and Hofmann reported upon the use of acetate of lead in sugar refining (1850), upon the London water supply (1851), and upon the adulteration of pale ales with strychnine (1882); Dumas was interested in many sanitary matters and made, among others, reports on the mineral waters of France (1851), on the water supply of Paris (1859), on the treatment of sewage (1867), and on the preservation of food (1870–72); Wurtz was for a number of years president of the *Comité consultatif d'hygiène* and a year before his death was president of the *Société de médecine publique.* His investigations and reports on sanitary subjects are numerous—on the disposal of the waste from distilleries and sugar-refineries, on the colors employed on German toys and in articles of food, on the adulteration of wines, etc.

Other names will occur to us—such as those of Sir Henry Roscoe, Sir Frederick Abel and Dr. Williamson, who served on the Noxious Vapours Commission of 1876; of Frankland, who gave years of service to the Rivers Pollution Commission of 1868 and in connection therewith devised an elaborate system of water analysis; we think also of Schutzenberger devising a method for the determination of oxygen dissolved in water (not, to be sure, simply for sanitary purposes), Mallet studying the various methods of water analysis, Remsen studying the organic matter in the air, and Leeds the practical effect of charging with oxygen (or rather with air) water used for purposes of domestic supply.*

I dwell intentionally upon the service of sanitary chemistry to public health science previous to the rise of bacteriology, because I believe that, dazzled as we have been and still are by the blazing achievements of bacteriology, beginning, let us say, with the discovery of the microbe of tuberculosis by Koch in 1882, students of public health science have been too much inclined to underrate the past services and present relative importance of sanitary chemistry. I know of few more important contributions to public health science, even since 1882, than the chemical work of the State Board of Health of Massachusetts under the able direction of my friend, Professor, afterwards President, Drown (the successor of Nichols) and his associates and successors; or that of another friend, the late Professor Palmer, of the University of Illinois, whose chemical studies of the rivers of Illinois will long remain a monument to a life full of promise and too soon cut short, or that of still another friend, Professor Kinnicutt, who fortunately is still engaged in fruitful work.

I have perhaps said enough, though it would be difficult to say too much, of the magnificent contributions to public health science of Pettenkofer and his disciples in sanitary chemistry; but the work of these investigators in *sanitary physics* and especially the physics of the soil, of the atmosphere, of the walls of buildings, and of heating and ventilation, in their relations to the public health are quite as important, and perhaps to-day even more neglected. In view of the increased facilities for transportation and the growing habit of traveling, together with the tendency to outdoor life, which seem to be characteristic to-day of all civilized nations, the next twenty-five years will probably see a re-

* Wm. Ripley Nichols, address before American Association for the Advancement of Science, *Proceedings American Association for the Advancement of Science*, Vol. XXXIV., 1885.

turn to the patient and exact studies of *the environment,* such as the chemists and physicists began, and have in some measure continued, since the middle of the nineteenth century. These studies will be directed largely to further knowledge and control of the environment, but they will not end there, for *personal hygiene,* owing to recent advances in physiology, is to-day one of the most inviting fields for work and education, and I hardly need to point out to a company of experts that the proper care and right use of the individual human mechanism reacts favorably and fundamentally upon the public health no less truly or effectively than an improved condition of the environment or of the public health tends to promote the welfare and long life of the individual.

The sphere of hygiene may be divided, as it often is, into the two hemispheres, public hygiene and personal hygiene, or it may be cut into one portion dealing chiefly with the human mechanism and its operation (*personal hygiene*), and another portion dealing chiefly with the environment of that mechanism (*sanitation*). The time has gone by when any one person can safely undertake to deal with the whole sphere of hygiene. The physiologist and the physician must in the future leave to the architect and the sanitary engineer such subjects as housing, heating and ventilation, water supply and sewerage, precisely as the sanitary engineer has never presumed to deal with foods and feeding, vaccines and antitoxins, exercise, sleep and rest. The former subjects deal chiefly with the control of the environment, the latter subjects chiefly with the control of the individual, and sanitation and hygiene must henceforward be regarded as separate hemispheres of the science of health.

The *science of architecture,* if under this head we include the principles of building construction, and the heating and ventilation of buildings, has done and is doing much of interest and importance to the student of public health science. For my own part, I am continually more and more impressed with the fact that the air supply, especially for the modern civilized and too often sedentary form of mankind, is in the long run quite as important as the water supply, the milk supply or any other supply. Surely, we can not be too careful of the purity of a substance which we take into our bodies oftener, and in larger volume, than any other, and which has come, rightly no doubt, and as the result of long and painful experience, to be known as the very breath of life. I am well aware that human beings may survive and seemingly thrive, even for long periods, in bad air, but I am certain that for the best work, the highest efficiency, the greatest happiness and the largest life, as well as for perfect health, the very best atmosphere is none too good. Hence I believe that the permeability of the walls of houses and other buildings, and the heating and ventilation of dwellings, school houses, churches, halls and other public places, require, and in the near future will receive, a much larger share of our attention than they have to-day.

In an age characterized by urban life and possessing sky-scrapers, tenement houses and other huge bee-hives, in which human beings aggregating vast numbers spend a large part of their lives, buildings require for their proper construction, lighting, heating, air supply, water supply, gas supply and drainage, the scientific services not only of architects, but of engineers, and such public buildings form one small section of the aid which modern *engineering science* is now everywhere rendering to public health science. The present has rightly been called an 'age of engineering,' and to no other science, excepting only medicine itself, is public health science to-day more indebted than to engineering science. I have referred above to the construction of the first municipal filter attached to a public water supply as that of the Chelsea Company of London, constructed in 1829. How different is it to-day! Not only nearly the whole of London, but also Berlin and Hamburg, and a thousand lesser cities all over the civilized world, are now protected more or less perfectly from epidemics of typhoid fever, Asiatic cholera and other water-borne diseases by vast municipal filters, ingenious and scientific in design and costly in construction, the work of skillful and faithful engineers, and monuments, more precious, if less enduring, than brass, to the contributions of engineering science to public health science. Innumerable storage reservoirs and vast distribution systems for supplies of pure water also bear witness to the enormous debt which public health science owes to engineering science, as do proper street construction and, still more, those splendid systems of sewerage with which so many modern cities are equipped, and which not only serve to remove quickly the dangerous liquid waste of human and animal life, but also keep low and wholesome the level of the ground water, reducing dampness and promoting dryness of the environment, and thereby strengthening that physiological resistance by means of which the human mechanism fights against the attacks of infectious disease. Nor do the services of engineering science end here, for the fluid content of the sewers must always be safely disposed of, and sewage purification is to-day a problem of engineering science no less important or difficult than that of water purification. These same processes of the purification of water and sewage are matters of so much moment in public health science that in almost every country experiment stations are now maintained at public and private expense for the purpose of working out the most practical and most scientific methods of purification.

In no respect have the services of engineering science to public health science been more conspicuous than in the application and the further study of the principles involved in the processes of water purification. It has lately been shown, for example, that the introduction of pure water supplies has in many cases so conspicuously lowered the general death rate as to make it impossible to escape the conclusions (1) that the germs of a greater number of infectious diseases than was formerly supposed are capable of prolonged life in, and ready conveyance by, public water supplies, and (2), as a promising possibility, that as the result of the greater purity of the water supply the physiological resistance of the consumers of pure water supplies is enhanced, in some manner as yet unknown; the net result being that the general death rate is lowered to such an extent as to lead to a rapid increase of population in communities previously stationary or multiplying far less rapidly. In the case of the city of Lawrence, Mass., for example, I have recently had the privilege of examining the results of studies by the distinguished hydraulic and sanitary engineer, Mr. Hiram F. Mills, which show that since the introduction of a municipal filter, which purifies the water of the Merrimac River supplying water to the citizens of Lawrence, while the population has increased nearly seventy per cent., the total number of deaths remains about the same as it was ten years ago. Mr. Mills concludes from the results of his studies—and I see no escape from his conclusions—that the introduction of the municipal filter has not only saved the lives of thousands of citizens, but has also caused the population to increase to a point much beyond any which it would have reached had the city continued to use, unpurified, the sewage-polluted water of the Merrimac River. A demonstration of this sort shows how easily the diminishing increase of population under a lower birth rate may sometimes be counteracted without resort to that fish-like spawning which seems to be the only remedy of those who are terrified by 'race suicide,' so called. Moreover, it is hardly necessary to point out that such a diminishing death rate means a far more rapidly diminishing morbidity rate—in other words, it means a heightened working efficiency of the population as a whole, and it must not be forgotten that for most of the results obtained in the scientific purification of water supplies we are indebted to the science of engineering.

On the other hand, we must observe that engineering science, so far as water purification is concerned, is as yet only in its infancy and by no means thus far altogether satisfactory. In the United States, for example, in the last two or three years a number of epidemics of typhoid fever have resulted from the *defective operation or construction* of municipal filters, and while much has been done, it is clear that much still remains to do. In this connection it should be said that public health science in the United States suffers constantly and severely from an unsatisfactory condition of the science and art of administration or government in many American cities. Public health works are too often neglected, delayed, mismanaged or built at extravagant cost, to the sanitary and economic damage of the people as a whole, and the tendency is far too common to place the care and operation of costly devices or systems in incompetent hands. I can not here dwell, as long as I should like to do, upon the mutual relations of public health science and the sciences of legislation and administration. Speaking of my own country alone, I must confess that we are still very deficient in the applications of these sciences. We have not even a national board of health, although we have, fortunately, in the Public Health and Marine Hospital Service a strong substitute for one. The peculiarities of our democratic and republican government have hitherto made it impossible for the people of the United States to secure either from federal authorities or from more local sources that measure of paternal sanitary and hygienic protection which they ought to have, and it is the duty of every American worker in this field to bend his energies toward a better organization of the public health service in every direction, municipal and state as well as national. The appointment in 1886 of a distinguished hydraulic engineer to membership on the State Board of Health in Massachusetts marked an epoch, so far as America is concerned, in both sanitary legislation and administration. This appointment was a formal recognition on the part of the public of the necessity of a larger proportion of engineering science in matters relating to the public health, and the results have justified the new procedure. It is now, fortunately becoming less rare in America to secure the services of engineers upon such boards and there can be no question that participation of the expert laity with medical men is likely to be extended, probably far beyond our present ideas.

In a notable discourse before the International Medical Congress at the Centennial Exposition held at Philadelphia in 1876, Dr. Henry P. Bowditch, of Boston, one of the pioneers of hygiene and sanitation in America, divided the century then closing, as to its relation to public health science, into three periods, the first, from 1776 to 1832, a period of reliance upon authority and upon drugs; the second, from 1832 to 1869, a period of true scientific observation; the third, from 1869 onwards, an epoch in which the medical profession is aided by the laity and state hygiene is inaugurated. Dr. Bowditch has much to say of the desirability of a wider cooperation of the laity in state hygiene and remarks: 'In all that tends to the promotion of state hygiene hereafter the laity will naturally and cordially cooperate with the [medical] profession.' The history of public health science shows Dr. Bowditch's prediction to have been well grounded. The names of John Howard and Captain Cook in the eighteenth century, and of Edwin Chadwick, John Simon and Louis Pasteur (not to mention a host of lesser workers) in the nineteenth century, show conclusively that public health science has been, even from the start, by no means confined to medical men. We may go further and say that even when forwarded by medical men these have seldom been busy practitioners. Sir George Baker and Jenner were, it is true, of this class, but not Pettenkofer or Koch or Ross or Billings or Reed.*

Reflections of this sort naturally lead to a consideration of the reciprocal relations of public health science and the science of education. I do not need to dwell upon the beneficial effects of public health science upon the hygiene and sanitation of school children or school houses. These benefits have long been emphasized by sanitarians and sanitary reformers, and are sufficiently obvious. The reverse of the picture, however, is by no means so well understood. Unless one is familiar with the facts, it is difficult to conceive how little impression the splendid progress which the last fifty years have witnessed in public health science has as yet made upon the curriculum of education. From top to bottom and from bottom to top the schools, whether primary, grammar, high, normal, technical, medical or any other class, are recreant, inasmuch as they neglect almost wholly any adequate training of their pupils in the principles of public health science, which are confessedly of such profound importance to mankind. There is, to be sure, just now a popular wave of enthusiasm touching the extermination of tuberculosis, but in the United States, at any rate, both schools and universities are singularly negligent of their most elementary duties in this direction. Yet if what I have said before is true, if the laity are to participate from this time forward with medical men in sanitary and hygienic legislation and administration, if engineers and medical men in particular are to serve upon boards of health or in other executive positions connected with public works, then, surely, it is the duty of the science of education to lend its powerful aid and not to fail to save the lives and health of the people as these can be saved to-day, but always to promote that public health and that large measure of consequent happiness which can probably be more easily and quickly accomplished in this way than in any other.

As to the function of medical education and engineering education in respect to the dissemination of public health science, I shall say only a word. In spite of the reiteration by medical men of their belief in the importance of hygiene and preventive medicine as a part of the equipment of the medical profession, it is a significant fact that in America even the

* "During the course of an epidemic physicians are too busy to make observations which require much time or care, or to make more than brief notes."—J. S. Billings.

best medical schools devote very little time to any adequate instruction in these subjects. It may be that this is wise and that the pressing necessities of practical medicine forbid any extended instruction in public health science. I am willing to believe, if I must, that this may be the case; but if it is, then the community must look for the most part elsewhere than to medical men for adequate investigation, legislation and administration of public health science. Medical men, must, of course, always participate in the work, in connection, particularly, with the control of epidemics and in those forms of preventive medicine which have to do with vaccines, serums and other means of modifying the vital resistance of the human body. But as regards the care and control of the environment, medical knowledge is not indispensable, and the entrance of the engineer and the sanitary expert upon the field, as foretold by Dr. Bowditch nearly twenty years ago, is today a conspicuous, and probably a wholesome, fact. As to the attitude of engineering education toward public health science there can be no question. If what I have said before is true, then engineers are bound in the future to take constantly a larger and more important part in public health work, and must be informed, and if possible trained, accordingly. Moreover, as regards both medicine and engineering, the problem is by no means insoluble, for a very short course of instruction rightly given would easily inculcate the necessary fundamental principles, while electives or post-graduate work might enable those few whose tastes led them in this direction to investigate and specialize and more thoroughly prepare themselves for public service.

I can not treat, nor do I need to treat, as thoroughly as I would be glad to do, the mutual relations existing between medical science, especially the science of medical bacteriology, and public health science. These are already sufficiently obvious and well known. From time immemorial medical men have served, often devotedly and sometimes heroically, in the cause of public health science. I take it, however, that since we have in this congress and in our own department a section of preventive medicine, I may pass over without comment this part of my subject.

As regards sanitary bacteriology, however, the relations existing between this and public health science are so fundamental, so extensive and so important, not only on the medical, but also on the engineering side, that although we have also in this congress under the department of biology, as is entirely proper, a section of bacteriology, I may linger at this point for one moment. The bacteria and other microscopic forms of plant and animal life, all of which are conveniently included under the term microbes, have so lately begun to be understood and appreciated that we must still emphasize their extreme importance. The discoveries of the botanists and zoologists and revelations of the microscopists in this domain are comparable, in their importance to public health science, with nothing less than the revelations of the telescope to astronomy. Astronomy had, indeed, existed long before the invention of the telescope, and public health science, as we have shown above, had its beginnings nearly a century before any considerable progress had been made in micro-biology. But it is not too much to say that the developments in micro-biology since Pasteur began his work have not only revolutionized our ideas of the nature of the infectious diseases, but have also placed in our hands the key of their complete control.

Concerning the relations of *physiology* to public health science, I must not fail to speak. Here is a field absolutely ripe for the harvest, but one in which the harvesters are as yet very few. I have lately had occasion to examine somewhat carefully the present condition of our knowledge of personal hygiene—which is nothing more (and should be nothing less) than the applications of physiologial science to the conduct of human life—with the result that I have been greatly impressed with its vast possibilities and promise. Man is a gregarious animal, and mankind is to-day crowding into cities as perhaps never before. Moreover, the industrial and commercial age in which we live is characterized to an extraordinary degree by the sedentary life. Yet the sedentary life is almost unavoidably an abnormal life, or at least it is a life very different from that lived by most of our ancestors. In the sedentary life the maintenance of a high degree of physiological resistance apparently becomes difficult, and if the vital resistance of the community in general is lowered then the public health is directly and unfavorably affected, so that considerations of personal hygiene have a direct bearing upon the science of public health.

There are, to be sure, interesting and suggestive symptoms of a wholesome reaction, in America, at any rate, against the evils of the sedentary life. Parks and open spaces are being liberally provided; public and private gymnasiums are rapidly coming into being; public playgrounds are thrown open in many of our cities, free of expense to the laboring, but, nevertheless, often sedentary, population; vacations are more than ever the fashion; sports and games are everywhere receiving increasing attention; while public baths and other devices for the promotion of personal hygiene are more and more coming into being. All this is as it should be, but all is as yet only a beginning. Here, again, the science of education is sadly at fault and in the direction of educational reform as regards personal hygiene lies immense opportunity for a contribution to public health science.

The science of *statistics*, which has done great service in public health science in the past, is likely to do much more in the future. Without accurate statistics of population, mortality and the causes of sickness and death, the science of epidemiology is impotent, and the efficiency or inefficiency of public health measures can not be determined. And yet in ignorant hands statistics may be worse than useless. It is a matter for congratulation to Americans that we now have in Washington a census bureau permanently established and under expert supervision, but until the various states and cities of the United States follow this excellent example of their Federal Government, one of the most important aids to public health science will continue to be wanting, as is unfortunately too often the case to-day not only in America, but in many other parts of the civilized world.

William T. Sedgwick.
Massachusetts Institute
of Technology.

SCIENTIFIC BOOKS.

Manual of the Trees of North America (Exclusive of Mexico). By Charles Sprague Sargent, director of the Arnold Arboretum of Harvard University, author of the Silva of North America; with six hundred and forty-four illustrations from drawings by Charles Edward Faxon. Boston and New York, Houghton Mifflin and Company; Cambridge, The Riverside Press. 1905. Pp. 24 + 826, octavo.

A few years ago Professor Sargent brought to a successful close his monumental work, 'The Silva of North America,' in fourteen massive quarto volumes, and including descriptions and figures of 585 species of trees.

While this must for centuries be the standard work on our native trees, its bulk and cost preclude its use elsewhere than in the herbarium, museum or library, and it was imperative that the same author should prepare a handy field (or rather, forest) manual which should give to a much larger number of people the opportunity of studying our forest trees. This has now been done in an admirable manner in the Manual which made its appearance some time in March of the present year.

The book opens with a synopsis of the sixty-one families of plants included, the sequence being that of Engler and Prantl's 'Die Natürlichen Pflanzenfamilien,' and this is followed by an analytical key to the families, based on the characters of the leaves. Then follows the descriptive manual proper, in which after a clear and pretty full characterization of each family there is given a conspectus or analytical key to the North American genera. The characters of each genus are set forth much more fully than they are in the usual botanical manuals, and a paragraph is usually appended giving geographical, numerical and economic data. A convenient key enables the student to readily find the particular species in which he is interested.

The specific descriptions leave nothing to be desired, usually including full descriptions of the leaves, flowers, fruits, seeds, the tree as a whole, its winter buds, bark and wood, and are followed by concise accounts of their natural geographical distribution, and the extent of their cultivation for ornamental and other purposes. With each species is a figure of the characteristic features of the species, usually the foliage, flowers and fruit. By means of these figures alone one can identify nearly every species.

The book is thus thoroughly satisfactory, and must at once become a standard among systematic manuals. It will appeal to the general botanist as a distinct and notable contribution to the literature of systematic botany, and at the same time it will be recognized by students of forestry as an indispensable handbook. For the latter, in this day of forestry schools and forestry courses of study in the colleges and universities, it is indeed fortunate that this manual has made its appearance. Without it North American dendrology was a most difficult subject for both professor and student, on account of the scattered and uncoordinated descriptions in the botanical manuals—the 'Silva' being quite too expensive a work for every-day use by students. This difficulty is now wholly removed by the publication of the manual.

Looking over the families which include North American trees, one finds that the conifers number 90 species and varieties; the palms, 10; *Liliaceae*, 9; the *Juglandaceae*, 15; *Salicaceae*, 32; *Fagaceae*, 52; *Rosaceae*, 169 (of which 132 are species of *Crataegus*); *Leguminosae*, 34; *Aceraceae*, 17; *Cornaceae*, 8; *Ericaceae*, 9; *Oleaceae*, 19. The generic and specific nomenclature is modern, so that one finds *Tumion* (instead of *Torreya*), *Hicoria* (instead of *Carya*), *Toxylon* (instead of *Maclura*), *Malus* (instead of *Pyrus*), *Sassafras sassafras* (instead of *Sassafras officinale*), and *Catalpa catalpa* (instead of *Catalpa bignonioides*). No attempt is made to cite synonyms, the author evidently assuming that the student might well trust him in the selection of the oldest available name. The author has added a handy glossary of technical terms, and the volume closes with a very full index in which English and Latin names are arranged in a single alphabetical series, thus avoiding the nuisance of two indexes, one for the common and another for the scientific names.

This book suggests to one that Professor Sargent is the man to give us a similar book devoted to the exotic trees (and probably shrubs also) of which so many are now given in this country.

Charles E. Bessey.
The University of Nebraska.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Comparative Neurology and Psychology for May contains an article of 100 pages, entitled 'The Morphology of the Vertebrate Head from the Viewpoint of the Functional Divisions of the Nervous System,' by J. B. Johnston, of West Virginia University. The 'head problems' have recently received renewed study from the standpoints of comparative anatomy and comparative embryology by some of our ablest morphologists, but none of these researches appears to give adequate attention to the recent phases of the doctrines of nerve components and the functional subdivision of the nervous system. Professor Johnston reviews this literature exhaustively from the new point of view and in the light of his own researches (partly not before published), discussing the problems of head morphology and segmentation with illustrative diagrams and tabular summaries. The phylogeny of the organs of special sense is discussed fully with reference to their primitive segmentation and their derivation from more primitive types of sensory mechanisms.

Bird-Lore for May–June contains the following leading articles: 'The Motmots of our Mexican Camp,' C. William Beebe; 'Some Early American Ornithologists, II., William Bartram,' Witmer Stone; 'The American Bittern at Home,' E. G. Tabor; tenth paper on 'The Migration of Warblers,' W. W. Cooke; Notes and Book News and Reviews. The section devoted to 'The Audubon Societies' contains much encouraging information in regard to bird protection, but shows that continued effort is still necessary, particularly in the case of game birds. The final paper is a 'leaflet' devoted to the Barn Owl and showing his good qualities as a mouser.

The Popular Science Monthly for June contains papers by the following contributors:

William A. Locy: 'Von Baer and the Rise of Embryology.'

Edward S. Holden: 'Galileo.'

Arthur H. Daniels: 'The Teaching of Logic.'

Charles A. White: 'The Mutations of Lycopersicum.'

Henry S. Williams: 'What is Research?'

W. J. Beal: 'Plants that Hide from Animals.'

SOCIETIES AND ACADEMIES.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 168th meeting of the Geological Society of Washington was held on April 26 at the Cosmos Club.

As informal communications, Mr. L. C. Graton exhibited photographs of Taughannock Falls, New York, and Dr. F. E. Wright explained a new method of determining the optical character of minerals. The regular program included the following papers:

The Ore Deposits of the Ouray Quadrangle, Colo.: Dr. J. D. Irving.

The ore-deposits are located in a small area of about three and one half miles square in the precipitous country in the near vicinity of Ouray, Colo.

The rocks of the region comprise a series of sedimentaries ranging in age from Algonkian to Cretaceous, with included porphyries, while the higher hills are capped by thick beds of volcanic tuff.

The ores are classified as silver-bearing fissure veins, gold-bearing fissure veins, replacement deposits in quartzite, replacement deposits in limestone.

The silver-bearing fissure veins penetrate the sedimentaries and pass occasionally upward into the volcanic tuff. They carry galena, tetrahedrite and some other sulphide in a gangue of barite and quartz. Replacements of limestone occur where beds of this rock are penetrated by the fissures. The silver values are present in the tetrahedrite.

The gold-bearing fissure veins are associated with intrusive dikes of monzonite-porphyry, and contain chiefly auriferous pyrite with some chalcopyrite in a gangue of quartz and crushed country rock.

The replacement deposits in quartzite are flat shoots of gold-bearing pyrite with a little galena and other sulphides which have been deposited in quartzite. It is thought that they owe their origin to alkaline waters that have ascended to the quartzite through minute fissures. The quartzite is fully replaced only in the neighborhood of the fissures and is surrounded by empty solution cavities in the quartzite resembling those usually encountered in the limestone beds. The ores range from $30 to $600 in value.

The replacement deposits in limestone are of three kinds. One is in the limestone beds along the courses of the normal fissure veins where they form flat, lateral enrichments of such veins.

2. Large flat bodies of silica and barite with silver-bearing ores associated with minute supplying fissures.

3. Deposits of gold-bearing ore composed of an intimate mixture of pyrite and magnetite with actinolite, quartz, epidote and other minerals of supposed contact origin. This class of deposit carries low values in gold and is thought to have been deposited by replacement together with the associated minerals by circulating waters subsequent to the porphyry intrusions.

The geological age of all of these ores is Post Eocene.

Structure of the Great Plains and the Mountains on their Western Margin: N. H. DARTON.

With this communication there was presented an illustration showing the configuration of the Dakota sandstone under the Great Plains and on the flanks of the uplifts westward. This widespread formation has been extensively explored in its underground distribution, by numerous deep wells, and its outcrop area has been mapped so that the structure of much of the region which it underlies is ascertained. This structure was shown by 100- and 500-foot contour lines and it exhibits many notable features. In general, under the Great Plains, the formations have but little dip and wide areas are monoclinal. The uplifts along the mountain border and in southeastern Colorado are marked features and it has been discovered that there is a low anticline extending across north-central Kansas and western Nebraska nearly to the Black Hills. In the bottom of the basins about Denver and northeast and northwest of the Black Hills the Dakota sandstone lies below sea level. In eastern South Dakota it abuts against the Sioux quartzite and is overlapped by Benton formation.

Two diagrams were exhibited, illustrating the configuration of the Black Hills and Bighorn Mountain uplifts by contour lines drawn at the surface of Minnekahta limestone in the former and Bighorn limestone in the latter. In the central area of these uplifts, where the sedimentary beds have been removed by erosion, hypothetical contours are given. Both these uplifts are of the 'Uintah type,' steep-sided and flat-topped and evidently due to direct upward pressure and not to crustal contraction. Profound but local faults along the east side of the Bighorn Mountains are notable features, due mainly to local uplift in Laramie time.

Fault Phenomena Near Glen Echo, Md.: G. K. GILBERT.

The locality is a disused quarry on the north bank of the Chesapeake and Ohio Canal, about one fourth mile east of Glen Echo. The rock is gneiss. It is traversed by numerous systems of joints, as many as twenty having been noted. These are inclined in various directions and at various angles. The joints of each system are approximately parallel, with interspaces ranging from a few feet to at least several yards. The joint surfaces most broadly exposed are not true planes, but show curvature. Many of the joints are evidently surfaces of slipping, or fault planes, the observed dislocations ranging from a fraction of an inch to two or three feet.

The joint systems may be classed in two series, of which one is younger than the other. Many of the joint faces of the younger series are slickensided, and some of the joints contain veins of quartz. The older joints show no slickensides and carry no veins, although there is independent evidence that they are planes of faulting. Their surfaces have a faint but persistent undulation or mammillation.

Where two fault planes of the older systems intersect, each is dislocated by the movement along the other, but the dislocated parts are connected by a fluted surface suggestive of an ogee molding. This phenomenon is supposed to indicate simultaneous (or alternating) movement on the intersecting planes while the rock was within (or at the border of) the zone of flowage. Similar movement in the zone of fracture produces splintering or crushing at the intersections.

The joint systems are interpreted as the results of successive strains distributed through a long period, the older having occurred when the rock lay below the zone of fracture.

Geo. Otis Smith,
Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

The 159th regular meeting was held Thursday evening, May 11, 1905, in the assembly hall of the Cosmos Club.

The first paper, entitled 'Chemical Glassware,' was presented by Mr. Percy H. Walker. Analyses and tests of durability and solubility of a number of beakers and flasks were given, and samples of the various glasses shown. The most suitable for chemical use were zinc boro silicates, and may be distinguished by permanent trade marks. Much of the lime alkali silicate glass sold in this country is of very poor quality.

The second paper, entitled 'A Colorimeter for General Use,' was presented by Dr. Oswald Schreiner. The speaker called attention to the increasing use of colorimetric methods for purely analytical and commercial purposes for both organic and inorganic compounds, and also for carrying on scientific studies in physical, physiological, sanitary and agricultural chemistry. A colorimeter of improved form was then exhibited and described. The parts coming in contact with the liquids are entirely of glass, mounted in a camera of wood. This instrument has the great advantage of speed and accuracy combined with great versatility of application to colorimetric solutions, together with simplicity in construction.

The third paper, entitled 'The Occurrence of Extractives in Apple Skin,' was presented by Mr. H. C. Gore. The quantities were given in which apple wax and apple vitin occur in the epidermis of the apple, both on ripe apples and on apples examined at intervals during growth. The method of analysis of apple skins for apple wax and apple vitin, stated briefly, consisted of extracting the marc of the skin with petroleum ether, followed by chloroform, the petroleum ether extracting the wax and the chloroform removing the vitin. The extracted wax was green or yellow colored, and melted at 59°–60°. The crude vitin was a white powder tinged with green or yellow and melted at 240°–250° C. The two varieties of summer apples examined were poorer in these extractives than the five varieties of winter apples. The extractives were found to increase steadily during the growing season. In case of ripe winter apples the wax amounts to about 30 mgms. per apple, the vitin to about 60 mgms. The probable importance of such studies in connection with the disease resistance of fruits was discussed.

Mr. F. P. Dewey exhibited a specimen of sodium ferrocyanide.

A. Seidell,
Secretary.

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

The regular monthly meeting of the section was on April 17 at the American Museum of Natural History, with Dr. W. S. Day in the chair in the absence of Dr. Ernest von Nardroff. The program consisted of the following papers:

Purposes and Plans of the Solar Eclipse Expedition of August, 1905: S. A. Mitchell.

Dr. Mitchell gave an outline of the plans of the various expeditions to be made to observe the total solar eclipse which takes place next August and which will be visible in Labrador and Spain. He also spoke of the different problems that the members of the expeditions will endeavor to solve. The U. S. Naval Observatory expedition which Dr. Mitchell will accompany will go to Spain on the U. S. cruiser *Minneapolis* early in the summer. The paper was illustrated by lantern slides.

Variation of the Duration of Afterglow with Change of Electrical Intensity and Frequency of Oscillation of the Electrodeless Discharge: C. C. Trowbridge.

A long-continued study of the duration of afterglow has shown that smooth curves can be readily obtained showing the variation of the duration of the afterglow with change of pressure of the gas. It has been found that the maximum of duration of these curves, when the electrical intensity is small, is at the same pressure approximately as the minimum sparking potential of the electrodeless discharge, or the point at which the discharge is most easily started. Also, when the frequency of the discharge is altered by a change of capacity, the position of the maximum point of the duration curve is altered to correspond to the displacement of minimum sparking potential of the discharge.

Lengthening the spark gap and thereby increasing the electrical intensity inside of the vessel in which the discharge takes place changes the form of the duration curve, and when the electrical intensity is thus increased above a certain amount the curve obtained is completely altered in form. When the afterglow in the rarefied air is allowed to diffuse into a vessel cooled to liquid air temperature, the duration curve is displaced some distance towards the higher pressure and is also changed in form, other conditions being the same; otherwise, the duration of the afterglow, which in the experiments was approximately thirty seconds, was found to be little different than when the air is at normal temperature. That a long-enduring glow can be obtained at the low temperature of liquid air and a pressure approximately one tenth of one millimeter is obviously important in its bearing on problems of astrophysics.

The Figure of the Sun, an Explanation of the Motions of Mercury: C. L. POOR.

This paper, which is being published by the Academy, was read by title.

The meeting then adjourned.

C. C. TROWBRIDGE,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.
NEW YORK SECTION.

THE eighth regular meeting of the New York Section of the American Chemical Society was held at the Chemists' Club, 108 West 55th St., Friday, May 5, at 8:15 P.M. The chairman, Dr. Wm. J. Schieffelin, presided.

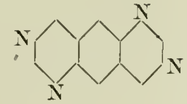
The program of the evening was as follows:

An Improved Form of Viscosimeter for the Testing of Oils: DANIEL D. JACKSON.

The earlier forms of instruments for the determination of the viscosity of oils consisted of bottles or bulbs which delivered a certain quantity of oil through an orifice of definite size. The necessity for jacketing such instruments soon became evident, and various methods were employed for this purpose. In only a few cases, however, has any attempt been made to protect the orifice so that a uniform temperature at this point would be assured, and in the cases where the orifice has been protected the oil under examination has been allowed to flow into a vessel which was outside the instrument. This causes a fall in temperature from the beginning to the end of the operation which is very considerable. A form of apparatus designed by the author for the testing of the viscosity of oil at 70° F. (21.1° C.) and 212° F. (100° C.) is so arranged that both the orifice and the oils under examination are kept at an exactly uniform temperature throughout the entire operation, and two very considerable errors in the results are thereby eliminated.

Condensation of Succinylosuccinic Ester with Guanidine: A. W. DOX and M. T. BOGERT.

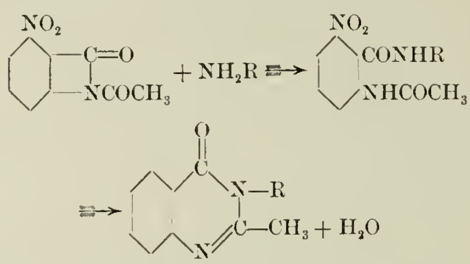
Various attempts were made by the writers to produce a naphttetrazine of the following structure:



The well-known quinazoline syntheses when applied to *p*-diaminoterephthalic acid, in which the anthanilic acid grouping is present on both sides of the nucleus, should give such a compound. But diaminoterephthalic acid proved to be very inert, and no condensations could be made with it. It was found, however, that succinylosuccinic ester and guanidine condensed to a derivative of the above naphttetrazine. The method of preparation and subsequent analyses showed the product to be 2, 6-diimino- 4, 8-dioxy-hexahydro- 1, 3, 5, 7-naphttetrazine. There is a possibility also that the compound exists in the tantomeric form, having two amino instead of imino groups. The substance is soluble only in caustic alkalies and strong mineral acids. From sodium hydrate it crystallizes as a di-sodium salt in beautiful yellow needles with green fluorescence. On the other hand, a sulphuric acid salt can be obtained in colorless rhombohedra by diluting the sulphuric acid solution with water.

Synthesis of Quinazolines from 6 Nitro-acet-anthranil: H. A. Seil and M. T. Bogert.

The 6 nitro-acet-anthranil was prepared by the action of acetic anhydride on acetanthranilic acid. It is much more reactive than the acetanthranil. It combines at once with primary amines forming first, the acid amide by direct addition, and then by loss of water passing over to the quinazolines.



The 6 nitro-acetanthranil is treated with an excess of the amine in a water solution of 1 to 3. It is brought to boiling and the excess of amine is distilled off. The solution is then made acid with acetic acid and filtered. The quinazoline thus obtained is purified by crystallization from alcohol.

The derivatives prepared are the methyl, ethyl, normal propyl, iso propyl, secondary butyl, iso butyl, iso amyl and allyl substitutions of the (2)methyl (5)nitro- (4)ketodihydroquinazoline. These are all white crystalline solids of high melting points; soluble in hot alcohol, slightly soluble in cold; soluble in dilute acetic acid (from which they can not be crystallized) and practically insoluble in water.

Influence of Organic Acids on the Precipitation of Antimony Sulphide: A. H. Peterson.

In the presence of a slight excess of mineral acids, relatively large quantities of certain organic acids prevent the complete precipitation of antimony sulphide by sulphuretted hydrogen. The influence was studied quantitatively and it was found that the influence was not directly proportionate to the masses of acid present, a limit being reached in each case, although the ratio of acid to the antimony present was inordinately large. The maximum effect obtained was for citric acid, which retains, in solution, seventy per cent. of the antimony present.

Of the acids studied, ethyl tartaric came next, then malic, while tartaric was the least energetic. The effect seemed confined to the oxy-acids, because succinic acid is without any effect and the influence of the citric acid is entirely lost when its hydroxyl group has been acetylated.

The Crystallization of Sodium Iodide from Alcohols: Morris Loeb.

It was accidentally observed that sodium iodide is extremely soluble in methyl alcohol and was not precipitated, even on the addition of considerable volumes of anhydrous ethyl ether. The alcohol solution, on cooling to room temperature, separates out crystals in long shining plates. Below 0° a voluminous mass of fine needles separates out, which are identical in composition, but different in appearance from those just mentioned. Melting point, 22 to 23°. Formula, $NaI.3CH_4O$. Under similar circumstances, ethyl alcohol dissolves the salt and crystallizes with it in proportion, $NaI.C_2H_6O$, while propyl alcohol yields $5NaI.3C_3H_8O$.

F. H. Pough,
Secretary.

THE TORREY BOTANICAL CLUB.

A meeting of the club was held at the museum of the New York Botanical Garden on Wednesday afternoon, April 26, 1905, with seventeen persons present and President Rusby in the chair.

The announced paper by Dr. P. A. Rydberg on 'The Composition of the Rocky Mountain Flora' was omitted by reason of the absence of the author.

'Notes on the Wire-Grass Country of Georgia' was the title of the paper presented by Mr. R. M. Harper.

The wire-grass country takes its name from the wire-grass, *Aristida stricta,* which is common all over it. In a broad sense, the wire-grass country coincides with the pine-barrens, which constitute about two-thirds of the coastal plain of Georgia, but for the present purposes the term is restricted to the Altamaha Grit region, an area of about 11,000 square miles.

The climate of the region, as compared with New York City, is about 18° warmer in winter and 9° warmer in summer. The rainfall averages about fifty inches a year, and most of it falls in the growing season. The geographical conditions are remarkably uniform throughout, and on account of this uniformity the flora is not very rich, only about one half as many species being known there as in the state of New Jersey, though the area is larger.

The region is naturally forested throughout, but the forests are mainly of long-leaf pine, which gives little shade. Consequently, the most striking feature of the vegetation as a whole is the adaptation to sunlight, usually manifested by reduction of leaf-surface.

The plants of the wire-grass country can be classified according to habitat into fifteen or twenty groups. The principal habitats are rock outcrops (constituting perhaps about one one-hundredth of one per cent. of the area), pine-barrens (over half the area), swamps, ponds, sand-hills, hummocks and bluffs, some of these with several subdivisions.

Civilization has influenced the flora principally through agriculture, lumbering, turpentining and fires. Only a small proportion of the land may be said to be under cultivation. Lumbering has little effect on the herbaceous flora, for the removal of the pine trees does not appreciably diminish the amount of shade. The turpentine operators have been practically all over that part of the country, and have done great damage to the forests. Fires sweep over most of the region every spring, being set purposely by stock-raisers to burn off the dead grass, but the fires do little damage where lumbering and turpentining operations have not been carried on.

The known flora of the Altamaha Grit region consists of about 725 native species of flowering plants, 75 weeds, 20 pteridophytes and 60 bryophytes and thallophytes. The lower cryptogams have been little studied. The largest families are Compositæ, 100 species; Cyperaceæ, 83; Gramineæ, 68; Leguminosæ, 50; Scrophulariaceæ, 30.

Some of the commonest species of the region are *Pinus palustris, P. Elliottii, P. serotina, Taxodium imbricarium, Aristida stricta, Serenoa serrulata, Eriocaulon decangulare, Quercus Catesbaei, Eriogonum tomentosum, Magnolia Virginiana, Sarracenia flava, S. minor, Kuhnistera pinnata, Cliftonia monophylla, Nyssa biflora, N. Ogeche, Oxypolis filiformis* and *Pinckneya pubens.*

The following species are common in the wire-grass country (each being known from at least three counties), but are seemingly confined to Georgia: *Sporobolus* (a species with terete leaves), *Rhynchospora solitaria* Harper, *Eriocaulon lineare* Small, *Polygonella Croomii* Chapm., *Siphonychia pauciflora* Small, *Viola denticulosa* Pollard (with leaves a foot and a half long), *Dicerandra odoratissima* Harper, *Pentstemon dissectus* Ell., *Baldwinia atropurpurea* Harper, *Marshallia ramosa* Beadle & Boynton and *Mesadenia* sp. (near *lanceolata*).

One of the most interesting features of the pine-barren flora, not generally known to botanists, is that the whole region was submerged beneath the sea in Pleistocene times, consequently the species now confined to the pine-barrens (from New Jersey to Texas), perhaps several hundred in number, have probably originated since that time.

Mr. Harper's remarks were illustrated by many photographs and specimens. The paper was discussed by Drs. Britton and Rusby.

Mrs. Britton then spoke of certain interesting southern mosses, especially of *Erpodium*, a curious genus having the habit of a *Frullania* or *Lejeunea.* A species of this collected many years ago by Sullivant at Augusta, Ga., was published by Austin as a hepatic under the name *Lejeunea biseriata.* Mrs. Britton discussed and exhibited also numerous mosses from the extreme southern part of Florida.

A few of these appear to be undescribed, but most of them are of species that are widely distributed in the West Indian region.

Dr. Rusby showed specimens of spurious ipecac roots which have found their way into the markets. The true ipecac (from *Cephaëlis Ipecacuanha* of the family Rubiaceæ) is now hard to obtain and high-priced. Some of the spurious root comes from other species of the same genus, but the most common adulterant is from the genus *Ionidium* (*Calceolaria*) of the family Violaceæ. Dr. Rusby exhibited also specimens of *Porteranthus stipulatus,* which is sometimes called the North American ipecac.

Dr. Britton showed living plants of two species of Crassulaceæ which had come into flower in the greenhouses of the New York Botanical Garden. One was *Sedum Nevii,* hitherto described from dried material, a species collected originally in southwestern Virginia, but since found to extend to Indiana. The other was a *Pachyphytum* from Mexico. Dr. Britton stated that in North America, north of the Isthmus, 284 species of Crassulaceæ may be recognized, distributed in 25 genera. Representatives of all these genera have now been studied in the living state.

Marshall A. Howe,
Secretary pro tem.

DISCUSSION AND CORRESPONDENCE.

THE METRIC ERROR.

To the Editor of Science: In your issue of March 24, Mr. Henry B. Hedrick, of the United States Naval Observatory, Washington, D. C., shifts from one metric fallacy to another. The regulation school children fallacy, as illustrated by the Hon. James H. Southard, chairman of the Committee on Coinage, Weights and Measures, in his report to the House of Representatives in 1902, and by Lord Belhaven in discussing a compulsory metric bill in the House of Lords on February 23, 1904, is that the adoption of the metric system will shorten the school life of every child, including all branches of study, from two thirds to three years; in other words, that the eight years will be cut down to seven and one third or even to five years. It is on this basis that Mr. Southard estimates a saving of $1,000,000,000 in every generation. It is clearly impossible to save by the adoption of the decimal system any of the time occupied by the study of non-mathematical branches, such as physical training, penmanship, languages, geography, history, nature study, drawing, cooking, sewing or music. The saving must be made in the time devoted to the study of compound numbers, weights and measures, which occupy 20 per cent. of the school arithmetic. Applying this rate, 20 per cent., to the 34½ weeks occupied during the eight years by all branches of mathematics, we find 6.8 weeks to be so consumed. This estimate is not only fair, but extremely liberal to the metric system. It is based on the eight-year schedule adopted for the public schools of New York City. The weekly time of 1,500 minutes is apportioned among the different branches, and the uncertain amount of time devoted to study outside of school hours is not included. Thus there is no confusion of schedule weeks with regular weeks. The case is simple. This metric fallacy is the claim that from two thirds to three years of the entire school life can be saved by the adoption of the metric system of weights and measures; when in fact, less than seven weeks is now devoted to compound numbers, weights and measures.

Turning from this old fallacy, let us consider the new one formulated by Mr. Hedrick to the effect that the adoption of the metric system would save ten per cent. of the time devoted to mathematics, or about two thirds of what may be called a mathematical year of school life. In other words, that 'the pupil would be about a year ahead in mathematics at the end of the eight years if he had only the decimal system to learn.'

In exposing this new fallacy it is unnecessary to dwell on the fact that the study of weights and measures in the school is merely very superficial memorizing and that the real knowledge of weights and measures is acquired outside of the school by using them; nor on the fact that the 34½ weeks covers geometry and algebra, from which the special study of weights and measures is excluded. We can ignore these considerations because the fallacy of Mr. Hedrick's claim is due chiefly to his assumption that the use and study of fractions can be restricted to decimals. That is impossible because the universe is not built that way. To save time by abolishing the study of vulgar fractions is to promote ignorance, not knowledge. Such a policy of saving, carried to its legitimate conclusion, would do away with all study and award diplomas for what the graduate from the school of ignorance does not know.

The earth, from which the French scientists a century ago thought they had derived the meter, persists in revolving on its axis $365\frac{20926}{86400}$ times during one revolution around the sun. Everything from the chemical combinations of the elements to the arrangement of the planets and fixed stars proclaims the eternal verity which John Quincy Adams thus expressed to Congress in 1821:

> Decimal arithmetic is a contrivance of man for computing numbers, and not a property of time, space, or matter. Nature has no partialities for the number ten, and the attempt to shackle her freedom with them will forever prove abortive.

It seems like a waste of time to demonstrate this self-evident proposition, but as many, including the House of Lords and the chairman of the Committee on Coinage, Weights and Measures of the House of Representatives, have reached the opposite conclusion, it may be worth while to ask them to examine a French arithmetic. Take that excellent work by Joseph Garnier, 'Traité complet d'arithmétique théorique et appliqueé au commerce, a la banque, aux finance et a l'industrie.' The fifth edition (1900) contains not merely a few incidental references, but many comprehensive chapters dealing with vulgar fractions. Here are a few chapter headings: 'Numeration et propriétés des fractions ordinaires,' 'Reduction des fractions au même denominateur,' 'Simplification des fractions ordinaires,' 'Conversion d'un numbre entier, et d'une expression fractionnaire,' 'Addition des fractions ordinaires,' 'Soustraction des fractions ordinaires,' 'Multiplication des fractions ordinaires,' 'Division des fractions ordinaires,' 'Conversion des fractions ordinaires en fractions décimales et réciproquement,' 'Fractions décimales periodiques,' 'Question sur les partages proportionnels, sur les mélanges.'

If these titles are not sufficient the metric advocate in English-speaking countries can be convinced by reading the French arithmetic and studying its problems. It includes 43 pages on the metric system; 12 pages on old pre-revolutionary weights and measures; 13 pages on the comparison of the old measures with the new; 22 pages on compound numbers; and 36 pages on vulgar fractions.

The chapter on the metric system, entitled: 'Poids et Mesures—Nouvelles Mesures au Système Métrique,' effectually dispels the illusion that the metric system in its entirety is simple. The system is explained there, not to make converts to the metric cause, but for practical application to every-day work. The metric system in the French arithmetic with its foreign nomenclature and combination of decimal with binary divisions, such as *hectolitre, demi-hectolitrc, double decalitre, decalitre, demi-decalitre, double-litre, litre, demilitre, double decilitre, decilitre, demi-decilitre, double centilitre and centilitre,* is the very uniformity of confusion. There are the same complex vulgar fractions and weird problems that one finds in all school arithmetics, only in the French form perhaps a little more weird. And all this in France more than a hundred years after the following decree was issued by Robespierre:

> Decree of August 1, 1793.
>
> Art. 1. The new system of weights and measures founded on the measurement of the earth's meridian and the decimal division will be used throughout the Republic.

In the face of such evidence, what is left of the claim that the metric system will save two thirds of a year or two thirds of a minute in the study of mathematics in school?

That the teaching of the metric system in American schools at the present time is but a pretense can be proved by asking any graduate a few simple questions. The fact is, that the introduction of the metric system into English-speaking countries, instead of making the education of the child easier, will make it vastly more difficult, because it will then be necessary to teach the old system, which will persist in use, and also to teach in fact as well as in name the metric system with the confusing ratios, direct and reciprocal, between the English and metric units.

If any one wants proof of this he can find it in the same French arithmetic. One chapter, 'Nomenclature des anciennes mesures et comparison avec les nouvelles,' treats of old units, a few of which are: *toise, pouce, ligne, aune, pas, lieue, perche, arpent, solive, corde, setier, muid, mine, minot, livre, once, denier, grain.*

If he still doubts let him go to some great French industry, textile manufacturing for example, and there study the chaos of weights and measures, thus described in 1902 by Paul Lamoitier, a French manufacturer:

> We are as much in the anarchy of weights and measures for the textile industry as at the time of the Revolution. * * *
>
> The famous aune, do you know its equivalent? Exactly 3 feet, 7 inches, 10 lines, and 10 points, or in other words, 1.188447 meters; the foot being equal to .324839 meter and divided into 12 inches, the inch into 12 lines and the line into 12 points.
>
> You would not imagine this as you are in the habit of calling it 1.19 meters. You laugh! It is, however, no laughing matter, unless you consider it as I do, profoundly ridiculous. * * *
>
> I will take my oath that the manufacturer of Rouen if he has not studied each section separately, has no idea what is the standard of Reims or the denier of Lyons or Milan. And on the other hand the manufacturers of Reims and Lyons are likewise puzzled in making comparisons of the diverse numberings of the diverse materials.

Such is the condition of French weights and measures at the present time. The evidence here presented is from French sources and makes ridiculous not only the claim of saving in education, but the whole metric proposition as well. This school children fallacy is confined to English-speaking countries where in the absence of experience with the metric system the imagination supplies the foundation for argument. The French labor under no such delusion.

Of course, if they insist, English-speaking countries can learn about the metric system in the high priced school of their own experience, but more than a century of experience in France can be had without money and without price. Samuel S. Dale.

Boston, Mass.,
March 27, 1905.

WILL THE METRIC SYSTEM SAVE TIME IN EDUCATION?

In the article entitled, 'The Metric Fallacy,' Science, March 3, p. 353, is the statement that, in the New York public schools: 'The time allotted for all branches of mathematics amounts to 34½ weeks for the eight years.' These figures relate to the actual time spent in recitation, which extends through nearly one year of school life, that is, about one eighth of the entire time. A complete education, to which Lord Kelvin referred in the British Parliament, includes high school and college, eight years more, which, with the same division of time, gives two years of solid mathematics. In England, one sixth, instead of one eighth is given to mathematics, and it is not extravagant to say that one half of this is wasted because of our barbarous weights and measures. Part of the economy of time shown in this country is due to our decimal money, part to the disuse here of many of the old English measures still taught in the English schools, and part to the greater use here of the metric system in our higher education, or perhaps it would be more correct to say, the non use therein of the English system.

Wm. H. Seaman.

SPECIAL ARTICLES.

THE PELÉ OBELISK ONCE MORE.*

The recent massive-solid extrusion from within the crater of Mont Pelé has been de-

* Descriptions of the 'dome' and of 'spine' or 'obelisk' of Mont Pelé, with references to many previous papers relating to the volcano, may be found in: Hovey, E. O., 'The New Cone of Mont Pelé and the Gorge of Rivière Blanche,' in *American Journal of Science*, Vol. XVI., 1903, pp. 269–281. Hovey, E. O., 'The 1902–1903 Eruptions of Mont Pelé, Martinique, and the Soufrière, St. Vincent,' in *Comptes Rendus IX. Congrès géologique international*, de Vienne, 1903, pp. 707–738.

scribed by several observers as consisting of two parts: a 'dome,' and a 'spine' or 'obelisk.' The former was a dome-shaped elevation developed within the crater, which occupied a large portion and in fact nearly the whole of its interior and overtopped its rim. It was situated directly over the volcano's conduit, and numerous explosions occurred in its summit portion. The latter, *i. e.*, the 'obelisk,' was situated on one side of the dome and rose as a mighty tower to a height of more than a thousand feet above it. While the two structures just referred to have been described as distinct, perhaps in part for convenience in recording observations, there seem to be good reasons, as will be stated below, for considering them as parts of the same massive-solid extrusion or, as termed by some writers, 'cumulo eruption.'

In explanation of the upheaval of a mighty spire or obelisk of rigid rock from within the crater of Mont Pelé, two hypotheses have been offered. The obelisk has been considered by several geologists as the freshly congealed and rigid summit portion of a column of molten rock or magma, which was forced out of its conduit in a massive-solid condition. A second hypothesis, advocated by Angelo Heilprin,* is in brief, that a plug of old lava, formed by the cooling and hardening of a residuum left in the conduit of the volcano after some previous eruption, was forced upward and in part extruded from the crater.

Of these two hypotheses the known facts seem to favor the acceptance of the first mentioned, for the reason, in part, that the decidedly vigorous eruptions of the volcano, especially during the earlier stages of its present period of activity, when vast quantities of fragmental material were ejected, show that the conduit had what may be designated as a free vent. The large size of the column of black, debris-laden steam, estimated at 1,500 feet in diameter at the base, which at times rose straight into the air for several thousand feet, is also proof that the conduit was not seriously restricted in its upper portion, and demonstrates that one large opening and not several small orifices was present. The great amount of dense and seemingly old lava mingled with scoriaceous and fresher appearing material which has been discharged, is apparently good evidence that the plug of old lava present in the conduit when the recent eruption began, was, in part at least, shattered and the fragments, together perhaps with masses of similar material torn from the walls of the conduit, widely distributed as ejected blocks, lapilli, dust, etc. There are still other considerations which favor the idea that the obelisk was formed by the recent congealing of a rising magma, rather than that it was a solid mass at the beginning of the recent period of activity. Among these considerations is the fact that the total vertical measure of the massive-solid extrusion, in case the obelisk had not in part fallen from time to time, would have been some five or six thousand feet. The frictional resistance of such a plug, if rigid throughout, would, as it seems, have been greater than even volcanic energy could have overcome, and certainly far greater than is demanded by the hypothesis that a magma was cooled and consolidated in its upper portion as it rose from below. Then, too, as observation seems to indicate, Mont Pelé is composed principally of fragmental material ejected during previous eruptions, and the walls of the present conduit may reasonably be assumed to be relatively weak, and in case it had contained a solid 'volcanic neck' to a depth of five thousand or more feet, the fresh discharges would have found an exit by means of a new or side opening instead of pushing the plug out vertically and causing explosions about its periphery.

Recorded knowledge concerning volcanoes is still too incomplete to enable one to form a well-substantiated judgment as to the manner in which the reopening of a conduit is accomplished after a period of quiescence and apparent extinction, but the best tentative view in this connection seems to be that a magma in a volcanic conduit requires a long period of time, possibly several thousand years, to lose sufficient heat to admit of a change to a solid

* Heilprin, Angelo, 'The Tower of Pelée,' published by J. B. Lippincott Co., Philadelphia and London, 1904, size 9 by 12 inches, pp. 1–62 and 22 plates.

condition to a considerable depth. When pressure is renewed at the base or basal portion of a conduit after a period of rest, presumably the still hot material contained in it would afford the path of least resistance for the ascent of material forced upward from deep within the earth, and the former avenue of discharge would be reopened. As will be shown later, there are reasons for assuming that the magma in the conduit of a dormant volcano solidifies progressively from its periphery towards its center, and that previous to complete consolidation there is a tube of rigid lava present, enclosing a vertical core of plastic or liquid rock. The summit portion of the material in the conduit of a dormant volcano, however, is always rigid and must be fractured and the fragments produced ejected, or else heat ascending from a depth, perhaps conveyed by gases and vapors, leads to a sufficient increase in temperature to cause the previously solid lava forming the summit of the plug to become partially or wholly viscous. Should a condition of inactivity continue sufficiently long to permit the magma in a volcano's conduit to become solidified to a considerable depth, say several thousand feet, it is reasonable to assume that a truly extinct condition would be reached and that an increase of pressure at a depth would lead to the formation of fissures and the opening of a new conduit.

The speculations just indulged in seem to favor the hypothesis that the obelisk of Pelé was composed of fresh lava in distinction from lava formed by the secular cooling of a magma left in the conduit at the close of some former eruption. On the other hand, the change of a fresh magma, rising from a depth, to a solid condition as it nears the summit of its conduit, implies a very rapid rate of change from a plastic to a rigid condition. In this connection it is to be remembered that during a certain period of eighteen days the growth of the obelisk of Pelé was at the rate of about forty-one feet per day. The suggestion here presents itself that the rate of downward progressing change from a plastic to a rigid condition might not have been the same as the rate of bodily ascent. Most probably each process was variable. The portion of the obelisk extruded during a certain period of time may have required a longer period of time for its consolidation.

Under the assumption that the obelisk of Pelé was composed of fresh lava, two chief methods or processes have been suggested by which a change from a plastic to a rigid condition of the material extruded was brought about. One of these explanations and the one I have previously favored, ascribes the loss of heat from the magma in the summit portion of a volcano's conduit, mainly to conduction through its confining walls, aided, and perhaps dominated by, the cooling influence of descending percolating water. Assuming that this is the main process involved or the one as may be said in control, it follows that the magma adjacent to the walls of the conduit in its upper portion would change to a solid condition previous to the central part; that is, in a given horizontal section consolidation would progress from the circumference toward the center. Coupled with this process and as it seems an accompaniment of any method of cooling after the protrusion of solid material has begun, is the loss of heat from the exposed summit-portion of the column by radiation, escape of steam and gases through fissures, the cooling influences of rain, etc.

Another process by which the cooling of a magma in the summit-portion of a volcano's conduit may be brought about, has recently been suggested by A. C. Lane* and G. K. Gilbert,† and is based on the principle that vapors and gases on expanding withdraw energy from surrounding media, the assumption being that a rising magma near the condition of consolidation and containing occluded vapors and gases, would experience a decrease of pressure as it rose; and in consequence the vapors and gases would expand and withdraw heat from the walls of the containing vesicles and promote their solidification. The application of this principle to rising magmas seems to be legitimate, but implies that material is removed from the summit of the ascending column; if the material dis-

* Science, December 11, 1903.

† Science, June 17, 1904.

charged is all in a massive-solid condition, as, for example, in case a solid plug is forced out of a volcano's conduit, there would be no loss of pressure so long as the plug or obelisk remained intact—except the probably negligible part due to decrease in atmospheric pressure with increase of ascent above the summit of the conduit—and consequently, no tendency to upward expansion. As the extruded material emerged from its conduit, however, there would be a conspicuous decrease in resistance to lateral expansion and the mass should enlarge laterally, and in consequence cool most rapidly by reason of the expansion of occluded steam and gases, in its peripheral portion. That is, there would be a tendency for the extruded mass to expand horizontally on escaping from its conduit, and the energy so utilized would decrease the tendency to upward expansion. The higher the mass rose above the summit of its conduit the greater would be the pressure on its basal portion due to its increasing weight, and for this reason, also, there would be a tendency toward basal enlargement. By reason of these two processes, in case no loss was sustained owing to explosions, dislodgment, etc., there would be a tendency for the rising mass to assume a bottle shape, *i. e.*, a circular tower with an expanded base.

The two methods of cooling just considered have a joint tendency to cause the outer portion of the ascending mass to become rigid at an earlier stage than the central portion, and hence to form a hollow rigid tube enclosing a more highly heated and perhaps still plastic central core.

An inspection of the admirable photographs of the obelisk taken by E. O. Hovey, Angelo Heilprin and others, shows that it was situated sub-centrally in the crater from which it was extruded, and adjacent to its northeastern border. The side facing the center of the crater was rudely concave and its outer margin in horizontal section, somewhat definitely convex. The photographs also indicate that subordinate crags within the crater and in part adjacent to the base of the obelisk, were so arranged that in a horizontal section at the level of the crater's rim they, together with the base of the obelisk, formed a rude circle. These deductions, together with the fact that explosions occurred from time to time at the base of the obelisk and, as seems to have been the case, mainly on its southwestern or inner side, suggest that the tower-like mass was a portion of the encircling wall of an essentially hollow plug of rigid lava constituting the new dome, which was forced upward and out of the summit of the volcano. That is, the obelisk was a portion of the wall of a tubular plug, the greater portion of which became broken and was dislodged as it rose. The 'cork,' in other words, was not solid throughout in cross-section, but composed of a rigid enclosing wall, with less rigid and perhaps still plastic material in its central portion.

If the above deductions from the study of photographs and the observations of others are well founded, they certainly indicate that the cooling and consolidation of the magma in the conduit of the volcano progressed from its periphery toward the center. At the same time, whenever portions of the summit of the column were removed by explosions, or a portion of the obelisk fell—there having been no overflow of molten lava—decrease of pressure on the part remaining must have occurred, thus favoring consolidation throughout the summit-portion of the truncated column on account of the expansion of occluded steam and gases as outlined above.

It is suggestive to note also, as having a bearing on the general process of volcanic eruption, that relief of pressure brought about in the ways just considered, would favor a renewed ascent of the material remaining in a conduit, and likewise a renewal of explosions at its summit.

In the light of the hypothesis that peripheral cooling was the controlling condition in the case of the recent massive-solid eruption of Mont Pelé, several seemingly discordant observations may be grouped in orderly sequence. For example, the conical mound of rough, glowing lava present in the crater and resembling a 'cone of eruption' during the days immediately succeeding the great eruption of May 20, 1902, may be considered as the congealed summit of a column of fresh lava which rose in the volcano's conduit. Beneath this hot and steaming initial plug, as may reasonably be assumed, the heat increased and the solid lava passed gradually into still plastic magma below. Cooling continued not only at the summit of the column as it rose on account of radiation, the escape of steam and gases from fissures, etc., and as has been suggested, on account of the expansion of steam and gases occluded in the magma, but also, and at a maximum rate, adjacent to the walls of the conduit principally through the influence of conduction and the ingress of surface water. The rise of the column, owing to pressure at its base, caused it to protrude from its encircling crater, but portions of its rigid wall fell or were shattered by steam explosions in its central part and only the remnants left standing reached a conspicuous height. The changes in the position of the obelisk as observed from time to time seem consistent with the explanation just offered, since the fall of one prominent spine or obelisk would leave some other portion of the rim conspicuous, and as it in turn was forced upward, seem to take the place of its fallen predecessor.

The fact that the outer surface of the obelisk, *i. e.,* its northeastern side, was striated vertically, owing to friction against the wall of the conduit from which it was protruded, is evidence that there was but little if any opportunity for steam to escape from below in that portion of the periphery of the crater. If the rising plug fitted its conduit equally well all about its contact with its enclosing conduit, it is difficult to understand where the numerous steam explosions which are known to have occurred adjacent to the base of the obelisk, were located—in case the plug was solid throughout its summit-portion. On the other hand, if it is assumed that the inner part of the rising column was less rigid than its outer portion, and as is consistent with this idea, perhaps even plastic at the center, it is legitimate to infer that the central portion of the summit of the rising column was removed by steam explosion, at the same time that the more prominent crags on the crest of its rigid peripheral portion were caused to rise high in the air.

Another series of facts which demands consideration in the above connection is that the rate of ascent of the dome and of the obelisk was not the same. Explosions occurring in the summit of the dome removed portions of its mass and a similar result was brought about in the case of the obelisk by the dislodgment of fragments. Varying conditions were thus introduced, but so far as can be judged the rate of ascent in either instance did not respond to these changes. Why the energy exerted in causing the massive-solid extrusion was not all consumed in elevating the core of the plug, where the resistance from weight was the least, and where the temperature was highest and consequently the tendency to plasticity the greatest, is far from clear. This is one of the considerations which advocates of the 'fresh lava hypothesis' to account for the production of the Pelé obelisk are called upon to meet. But in this connection, as in reference to the rapid rate of cooling demanded by that hypothesis, an adequate explanation does not seem to be at hand.

Sequence of Events.—The sequence of events during a massive-solid volcanic eruption, and the leading variations in what may be termed the normal process due to secondary conditions, may provisionally be grouped as follows:

If the magma forced upward from deep within the earth, through a volcano's conduit, becomes highly viscous or nearly solid before reaching the surface, it may be forced out of the conduit and expand in the crater to which the conduit leads. The amount of expansion will depend principally on the degree of plasticity of the mass, the range being from such a degree that the material will flow under the influence of gravity, to rigidity under the pressure present. The distinction between an effusive and a massive discharge is that the material extruded in the former instance is sufficiently mobile to flow and possibly to form a well-defined stream, and in the latter instance is so viscous or even rigid that lateral motion does not result. Between the two there is a complete gradation. The range in the physical condition of the extruded lava is from fluidity approaching that of water, to rigidity such as cold lavas ordinarily present.

The constructional shapes resulting from the extrusion of lava ranging in consistency from a highly viscous to a rigid condition, should form a sequence from irregular tumefactions and bottle-shaped towers, to angular crags with nearly vertical sides. A sequence of variations should also be produced owing to the amount of material extruded, its rate of ascent, etc. The constructional topographic forms should present destructional modifications, in case explosions occur, or portions of the extruded material are dislodged.

The results produced by massive-solid eruptions, as may be judged if all the modifying conditions are considered, are so varied that it is not practicable at present to follow each modification in detail. The place of the Pelé obelisk in the general sequence, however, may be readily indicated.

Under the hypothesis that the Pelé obelisk was composed of fresh lava, which congealed and became rigid, at least in part, as it rose through its conduit, and was protruded high in the air, let the reader endeavor to construct in fancy the topographic form that would have resulted, had there been no explosions and no loss owing to dislodgment. Under these assumptions the outer portion of the extruded mass would cool more rapidly than its central portion, and the surface might become rigid while the core was yet plastic.

FIG. 1. Ideal diagrams illustrating the shapes of massive-solid volcanic extrusions.

The extruded material at an assumed stage in the eruption would have some such form as is outlined in Fig. 1, *a*. At such a stage the highly heated core of the extruded column might serve as a continuation of the conduit and an escape of steam possibly with explosive violence and accompanied by fragmental discharges, occur in the pseudo-crater at its summit.

Providing explosions occurred as the dome rose, it might be more or less shattered. Vigorous explosions might remove the summit-portion of the ascending mass as fast as it was forced out of its conduit, and the fact that a massive-solid extrusion had occurred be masked so as to make it appear that only a fragmental-solid eruption was in progress or had taken place. It should be borne in mind that effusive, fragmental-solid and massive-solid eruptions with all of their varied accompaniments are but phases of a single process.

Vigorous explosions during the ascent of a column similar to the one suggested in Fig. 1, *a*, might cause the removal of a part of the material composing it, leaving portions of its solid exterior standing as angular crags and tower-like spines as shown in Fig. 1, *b*. This diagram, as the reader will recognize, is intended to indicate in outline—all suggestions as to accumulation of débris, and other secondary results being eliminated—the condition of the massive extrusion in the crater of Mont Pelé at the time the obelisk was most prominent. During the continuance of the conditions indicated in the diagram, vigorous explosions might occur in the truncated summit of the 'dome' while portions of its shattered periphery formed conspicuous eminences. Explosions of this nature, as has been observed, occurred in the summit of the 'dome' of Mont Pelé; and, as it is reasonable to assume, the final fall of the obelisk was due chiefly to the shocks caused by explosions at its base. The general shape that the extruded material would present after being truncated by explosions, is roughly indicated by Fig. 1, *c*.

The considerations just presented seem to make it reasonable to conclude as already stated, that the 'dome' and the 'obelisk' of Mont Pelé were parts of the same massive protrusion and that the various shapes assumed from time to time were due mainly to the shattering and in part the dispersion of the rising mass by steam explosions; also, that the material extruded in a massive condition consisted of fresh lava which was forced outward from deep within the earth. The observed results appear, also, to be consistent with the view that the cooling of the material extruded progressed most rapidly in its peripheral portion and that its central portion, particularly after partial truncation had occurred, was sufficiently hot to cause explosion accompanied by fragmental-solid discharges.* If these contentions are well founded, it follows that the exterior of the plug—considering the dome and the obelisk as portions of a single extruded mass—should be composed of dense and possibly vitreous rock, and become more and more scoriaceous towards its center.

The above suggestion in reference to the physical condition of the extruded material differs from the conclusion reached by me in the same connection, in a previous publication,† which was based largely on the observed granular condition of the rock present in the central portion of a massive-solid extrusion near Pauline Lake, Oregon.‡ This discrepancy seems to indicate that the conditions which modify massive-solid eruptions are more varied than is at present understood and that the results in any two instances may not be closely similar.

The theory of volcanic eruptions may instructively be pressed a step farther: As the cooling and consequent consolidation of a magma forced out of a conduit in a viscous or solid condition, progresses from its periphery towards its vertical axis, it follows that in case a volcano becomes dormant the same process will continue in the deeper portions of the conduit, and should eruptions be renewed after a period of rest, the avenues of discharge should be through the central part of the partially consolidated material in its throat. In case the energy of the renewed eruptions was not sufficient to fracture and discharge, or the heat adequate to re-fuse the consolidated lining of the conduit, it would remain, and if the process was repeated, the tube would become closed by successive additions to its rigid lining, and final extinction result.

In the case of Mont Pelé, the process just outlined is, perhaps, in progress, and the dense rocks in the rim of the crater, which form Morne Lacroix and Petit Bonhomme, be representatives of the outer portion of a previous eruption similar to the one of recent occurrence.

Generalizations.—The various forms which massive-solid volcanic eruptions may be expected to assume should be regulated by several secondary conditions, a number of which might be in operation during a single period of discharge, or some one dominate all the others. For example: (1) the physical condition of the extruded material may range from plasticity to rigidity, dependent upon the chemical composition of the rising magma, its temperature, rate of cooling, rate of ascent and probably still other conditions; (2) the degree of explosive energy may range from such intensity that the entire summit-portion of the extruded material would be blown away, to such feebleness that but little change would be produced in the constructional form due to extrusion; (3) differences in the rate of cooling and consequent consolidation may result in the formation of a solid plug, or a plug with a rigid exterior and a still plastic interior. Each of these various conditions would react on many, if not all, of the others, and in consequence the variations in the final result,

* The above considerations seem to be in harmony with the results reached by A. Lacroix, in a recently published volume ('La Montaigne Pelée et ses eruptions,' Paris, 1904). This report has not reached me, but a review by Ernest Howe, SCIENCE, April 14, 1905, contains the following statement: "Lacroix denies that it (the dome) is of fragmental nature and states that it is, in fact, a homogeneous mass of viscous lava surrounded by an envelope of the same substance cooled and consolidated. * * * The viscous magma on reaching the surface through the throat of the volcano and forming a protuberant mass is quickly surrounded by a solid shell or envelope which protects the still pasty interior from a too rapid cooling."

† Russell, Israel C., 'Criteria Relating to Massive-Solid Volcanic Eruption,' in *American Journal of Science*, Vol. XVII., 1904, p. 264.

‡ Mount Newberry, U. S. Geological Survey, Bulletin No. 252, 1905, pp. 97, 106–109.

whether considered geologically or topographically, have a wide range.

It is to be remembered, however, that massive-solid eruptions are but one phase of the volcanic problem and, for their complete elucidation, should not be rigidly separated from other phases of the same process.

Israel C. Russell.

RECENT VERTEBRATE PALEONTOLOGY.

FOSSIL MAMMALS OF MEXICO.

The mammalian paleontology of Mexico offers a most interesting field for investigation, since it promises to reveal the southern range of many North American Miocene and Pliocene types, as well as the northern range of South American types, Pliocene and Pleistocene, in addition to many types which will be found to be peculiar to Mexico. The literature of the subject is still quite limited, including contributions by Richard Owen,* by Professor Cope† and a recent interesting memoir by Dr. M. M. Villada,‡ of the National Museum of Mexico.

In connection with the proposed visit of the International Geological Congress to Mexico in the summer of 1906 the following cursory notes may be of interest.

The elephant remains in the National Museum have usually been ascribed to *Elephas columbi;* but they include molar teeth not only of this species, but of the much larger form, *Elephas imperator.* In the collection of the Geological Survey of Mexico in the new survey building are the skull and tusks of an *E. imperator* of magnificent proportions, the tusks measuring 5 m. 10 cm., or 16 feet 10 inches, in length; this specimen was secured during the excavations for the great drainage canal of the Mexican Valley. Owen's type of *Equus conversidens* and *Equus tau* from the valley of Mexico belong to the National Museum, but are not at present accessible, owing to changes in the building. There is, however, the skull of a Pleistocene horse from the valley of Mexico referred by Villada to *E. excelsus,* but probably belonging to a distinct and much more massive type of animal with exceptionally powerful postorbital arches. Here also is found the fine carapace of a glyptodon (*Glyptodon mexicanus*).

The new building of the Geological Institute of Mexico is being pushed forward to completion with a view to the visit of the International Geological Congress. The director, Dr. José G. Aguilera, very kindly exhibited to us the chief specimens of mammalian fossils. These include the skull of a mastodon probably related to the South American *M. humboltii,* the palate and teeth of a small variety of horse of the size of a donkey, labeled by Castillo in 1866, but not yet described. Besides the skull above noted there are several single teeth of *Elephas imperator,* molars of the *M. humboltii* type from Chiapas, of the *E. columbi* type from the village of Zacapù in Michoacan, of *E. imperator* from the valley of Puebla. In a bed of lignites, probably of Upper Miocene or Loup Fork age, were found the types of *Hipparion* (= *Protohippus*) *castillei* Cope, and teeth belonging to *Mastodon floridianus,* also teeth of the peccary. Also probably of Loup Fork age from the valley of Toluca is the jaw of a rhinoceros, a very short-skulled type, the canines being separated by very short intervals from the premolars, while the molar teeth are exceptionally long-crowned. Very large horse teeth found in the

* Owen, R., 'On Fossil Remains of Equines from Central and South America referable to *Equus conversidens* Ow., *Equus tau* Ow., and *Equus arcidens* Ow.,' *Phil. Trans.,* 1869, pp. 559–573. 'On Remains of a Large Extinct Lama (*Palauchenia magna* Ow.) from Quaternary Deposits in the Valley of Mexico,' *Phil. Trans.,* 1869, pp. 65–77.

† Cope, E. D., 'Review of Dumeril et Bocourt's Mission Scient. Mexique,' *Amer. Nat.,* Vol. XVIII., 1884, p. 162. 'Gigantic Bird from Eocene of Mexico, *Diatryana Gigantea,*' *Pr. A. N. S.,* 1876, p. 10. 'Extinct Mammalia of the Valley of Mexico,' *Proc. Am. Philos. Soc.,* Vol. XII., 1884, 117, p. 1. 'Report on Coal Deposit near Zacualtipan, Hildalgo, Mexico,' *Proc. A. P. S.,* XXIII., 122, 1885, p. 1. 'The Comision Cientifica of Mexico,' *Amer. Nat.,* XIX., 1885, p. 494.

‡ Villada, Manuel M., 'Apuntes acerca de la fauna fosil del Valle de Mexico,' *Anales del Musco Nacional de Mexieo,* T. VII., Entrega 14, Ma, 1903, pp. 441–451, 8 pll.

valley of Mexico may correspond with the large skull in the National Museum. Of great interest is the skull of a very large true cat, puma-like, found in the excavations of the Grand Canal.

From the Pleistocene near Zumbango, state of Mexico, remains of a large undescribed bear have been found. Here also is the type of *Glyptodon mexicanus*. A complete shield of the same animal is reported to be in the collection of the school of mines. In the same collection is found a fine specimen of *Bison latifrons* and remains of fossil horses.

The gravigrade sloths are represented by teeth from Tequixquiac.

From the state of Chihuahua, northern Mexico, are remains of Upper Pliocene or Pleistocene horses and llamas. Fossils are, however, most abundant in the Lower Pleistocene of Puebla near the city of Puebla in the village of Totemehuacan. A fine collection from this locality was lost by fire while on its way to the United States for study. An older horizon is also represented here. The mastodons were very widely distributed, teeth coming from Hidalgo, from the valley of Toluca, from Teul in the state of Zacatecas. Abundant elephant teeth are also reported by Mr. C. W. Beebe from the Lower Pleistocene, near Guadalajara.

In 1903 the Mexican government made provision for the increase of the staff of the Geological Institute which had been created by congress in 1888. The staff now includes the director, Dr. José G. Aguilera, an assistant director, six geologists, three assistant geologists, one chemist and assistant, three topographers. The director is now giving his most active attention not only to the actual field work of the survey, but to the extension of the library and to the arrangement of the collections, in preparation for the visit of the International Geological Congress.

H. F. O.

MUSEUM PUBLICATIONS.

The Annual Report of the Director of the Field Columbian Museum for 1903–1904 chronicles the steady growth of this great museum and emphasizes the necessity for having its collections transferred to permanent quarters as soon as possible.

This museum probably has the largest and best display of botanical material of any institution in the United States, and judging from the plates the specimens are very well exhibited. The collections illustrating mineralogy and economic geology are also large, well displayed and well labeled. But when it is stated that 500 labels were needed to *complete* the labeling of the gold and silver ores alone, it leads one to ask if there may not be such a thing as displaying too many specimens. We have all heard of the man who could not see the forest for the trees, and there is danger that the museum visitor may fail to grasp a few general and important facts on account of the number of details. The modern tendency of museums is to lessen the amount of material on exhibition and to increase its educational value, and there is no doubt that a small number of specimens well displayed and well labeled are more effective than a multitude of objects.

The list of Museum Publications is a strong one and the two volumes of Elliot's 'Land and Sea Mammals of Middle America and the West Indies' were most acceptable. Zoologists may not agree with Mr. Elliot in all his conclusions, but it remains to be said that no one but he has had the courage to attempt the task of bringing together and systematizing the present knowledge of the mammalian fauna of North America.

The Prize Essay Contest, published by the Carnegie Museum, forms a pamphlet of 68 pages, containing the addresses delivered on the occasion of awarding the prizes, with lists of the prize winners and contestants; although the essays themselves are not printed as has heretofore been the case.

Undoubtedly these contests do much to bring children to the museum, but it is a little questionable if they do not think more of the possibility of winning a prize than of the objects in the collections, and it would be interesting to know how many go again.

It is surely a good thing to induce the public to visit a museum, but might not the machinery of the Prize Essay Contest have achieved even more permanent results if used in some other way?

In looking over the reports of various museums it becomes evident that too much stress must not be laid on mere number of visitors. Three great institutions show a drop in 1903 or 1904 of from 70,000 to 50,000, while the United States National Museum exhibits a large increase, following a large decrease. None of the museums in which the attendance has declined has fallen off in the quantity or quality of their displays; on the contrary, they have made very great progress, and yet the public for some unexplained reason seems temporarily to have lost interest. How much the frequent expositions of the last ten years may have had to do with this it is impossible to say, but it probably has had its effect in decreasing attendance.

F. A. L.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR L. HERMANN, Königsberg, Professor H. A. Lorentz, Leyden; Professor Henri Moissan, Paris, and Professor Hugo de Vries, Amsterdam, have been elected foreign members of the Royal Society.

DR. FRIEDRICH KOHLRAUSCH, who recently resigned the directorship of the Reichsanstalt, and has changed his residence, has been made an honorary member of the Berlin Academy of Sciences instead of a resident member as hitherto.

M. LOUIS HENRY has been elected a corresponding member of the Paris Academy of Sciences, in the section of chemistry.

CAMBRIDGE UNIVERSITY has conferred the honorary degree of Sc.D. upon Commander R. F. Scott and Sir Francis E. Younghusband, K.C.I.E., LL.D.

THE Broca prize of the Paris Anthropological Society has been awarded to MM. Launois and Roy for their biological study of gigantism.

PROFESSOR GEORGE T. LADD, who has resigned from the chair of philosophy at Yale University, has arranged to pass the latter half of next year as professor of philosophy at Western Reserve University. At the close of the war in the east he expects to go to Japan to lecture on educational methods under the auspices of the Japanese Imperial Education Society.

DR. B. F. CLARKE, professor of mechanical engineering at Brown University, retires at the end of this year, in accordance with the pension regulations recently adopted by the corporation.

DR. G. F. HULL, Appleton professor of physics at Dartmouth College, will spend next year abroad, working in the laboratory of Professor J. J. Thomson, at Cambridge.

PROFESSOR OLIN F. TOWER, of Western Reserve University, has a six months' leave of absence, which he is spending at the University of Berlin.

DR. W. J. HUMPHREYS, Ph.D. (Johns Hopkins, '97) has been appointed chief physicist of the United States Weather Bureau, in charge of the new physical laboratory in the mountains of West Virginia, near Gap Mills. Before assuming his new duties, Dr. Humphreys will go abroad to study foreign laboratories.

MR. I. B. POLE EVANS, B.Sc. (Wales), has been appointed assistant for plant diseases under Mr. J. Burtt-Davy, government agrostologist and botanist of the Transvaal Department of Agriculture. Since October, 1903, Mr. Pole Evans has been working for his research degree at Cambridge under Professor Marshall Ward, being engaged principally in an investigation of the rusts of cereals. During this time he has been acting as demonstrator in elementary biology for Mr. Seward, and last term had charge of the practical work of Professor Marshall Ward's advanced course on fungi. The cereals of the Transvaal are greatly affected by parasitic fungi, and its flora presents a new and practically untouched field for the mycologist.

PROFESSOR BERNHARD PROSKAUER has been appointed head of the chemical department of the Institute for Infectious Diseases at Berlin.

THE courses that Professor Wilhelm Ostwald, of the University of Leipzig, will offer at Harvard University during the first half of the approaching academic year are: 'The Philosophy of Natural Science,' three lectures a week, and 'The Fundamental Conceptions of Chemistry' and 'Catalysis,' each one hour a week.

Sir Francis Younghusband gave the Rede lecture at Cambridge University on June 10, his subject being 'Our True Relationship with India.'

For the purpose of scientifically exploring the atmosphere, Comte de Castillon de Saint-Victor made an ascent on June 7, in his balloon *Centaure*, taking with him M. Joseph Jaubert, director of the municipal observatories of Paris, and Dr. Jolly. Other aerostatic ascents were made on the same day from Berlin, Strasburg, Barman, Munich, Vienna, Zurich, Rome and Trappes.

The statue of Sir Thomas Browne, which is being executed by Mr. Henry Pegram, A.R.A., is now well advanced, and it is intended that it shall be erected and unveiled in its position in the Haymarket, Norwich, on October 19, the tercentenary of Sir Thomas Browne's birth.

The class of 1904 of the University of Pennsylvania is collecting funds to erect a statue of Benjamin Franklin, the founder of the university. The class of 1905 has voted to erect a statue of William Smith, the first provost of the university.

Part of the old Speedwell iron works, near Morristown, N. J., in which Professor S. F. B. Morse and Stephen Vail perfected their first telegraph instrument, was destroyed by fire on May 22.

Dr. Ernst Küster, professor of surgery at the University of Marburg, will deliver the principal address at the unveiling of the memorial to von Esmarch, at Tönning, his birthplace, which will take place on August 6.

Dr. Albert Hilger, professor of applied chemistry at the University of Munich, died on May 18, at the age of sixty-six years.

There will be a civil service examination on July 5 for the position of aid in the Bureau of Plant Industry, Department of Agriculture, at a salary of $600 a year.

A collection of birds' eggs, consisting of complete sets, representing more than five hundred different species of birds, made by Mr. Gordon Plummer, has been presented to the biological department of Dartmouth College by his son.

Mr. J. Pierpont Morgan has presented to the American Museum of Natural History the George F. Kunz collection of meteorites, which has been on exhibition for some years as a loan. The collection comprises some rare specimens, including two which are unique and have never been described, and the largest mass (1,038 pounds) of Cañon Diablo which has been found. The department of conchology has received from Mr. F. A. Constable a gift of the last instalment of the celebrated Hirase collection of the land shells of Japan, and the series is now on its way to the museum. This instalment comprises about 1,000 specimens of shells belonging to 220 species, bringing the total of the Hirase collection in the possession of the museum up to about 4,000 specimens of 800 species. The series is fully representative of the land molluscan fauna of Japan, and while the specimens are not strikingly beautiful, they are of high scientific interest.

The sittings of the delegates appointed to consider the establishment of an International Agricultural Institute began at Rome on May 30. The London *Times* states that the conference has appointed three committees. The first, which will consider the organization of an international institute, has appointed as its chairman the French ambassador and as members the other ambassadors and some of the delegates to the conference, including Sir Thomas Elliott and Sir Edward Buck. The aims which the institute is to attain will form the subject of the second committee's attention. This committee will be divided into two sections, of one of which Lord Minto has been appointed president, while Sir Thomas Elliott is among the members. The task of the third committee is to examine the methods of defraying the expenses of the institute. Signor Rava, minister of agriculture, will preside over it, and Lord Jersey and Mr. Gill will be among its members.

It is announced that the *Proceedings of the Royal Society* is henceforth to be brought out in a new form. It will assume royal octavo size, and be printed in larger type than is the case at present. Also two series will appear in future, one embracing mathematical and physical papers, the other biological papers, and each part will be on sale to the public separately.

At a meeting of the Zoological Society of London on April 18, Dr. W. J. Holland, F.Z.S., director of the Carnegie Museum and Institute, Pittsburg, U.S.A., gave an account, illustrated by stereopticon slides, of the discovery of the skeleton of *Diplodocus carnegii* Hatcher, a reproduction of which he was installing in the Gallery of Reptiles at the British Museum (Natural History), South Kensington. After paying tribute to the generosity of Mr. Andrew Carnegie, who had supplied the funds necessary for the extensive explorations which were being carried on by the Carnegie Institute, under the direction of the speaker, he went on to speak of the geology of Wyoming and of the immediate locality, where the specimen was obtained. He incidentally described the methods employed by American collectors to secure vertebrate fossils in fine condition. He then discussed the osteology of *Diplodocus*, briefly pointing out some of the more interesting structural features of the skeleton, and in this connection animadverted upon certain so-called 'restorations' made public in popular magazines and emanating from artists whose artistic ability was quite in excess of their scientific knowledge. Dr. Holland concluded his account by exhibiting in rapid succession pictures of a few of the more remarkable skeletons which had been recovered by the paleontological staff of the Carnegie Museum from various localities in the region of the Rocky Mountains. At the same meeting Dr. Smith Woodward, F.R.S., read a paper on a unique specimen of *Cetiosaurus leedsi*, a Sauropodous Dinosaur from the Oxford Clay of Peterborough. He described the fore and hind limbs and the tail, and confirmed the observation of the late Professor O. C. Marsh, that *Citiosaurus* was one of the more generalized Sauropoda.

Mr. Edwin C. Eckel, of the United States Geological Survey has just completed a report on the cement materials and industry of the United States. In view of the phenomenally rapid growth of the cement industry within recent years, the publication of this report is exceptionally timely. In collecting data for it, Mr. Eckel visited every district in which cement is produced and examined nearly every plant in operation. Information relating to undeveloped deposits of cement materials was obtained by personal examination and from the published and unpublished work of other geologists. The discussion is in four parts, the first relating to the materials and manufacture of Portland cement, the second to Portland cement resources of the United States, the third to natural cement resources of the United States, and the fourth to the materials and manufacture of Puzzolan or slag cement. Few people realize how manifold are the uses of cement. In its importance to our present civilization it is surpassed among mineral products only by iron, coal and oil. In rate of increase in annual production during the last decade even these three products can not be compared with it. In 1890 the total production of Portland cement in the United States was 335,500 barrels, valued at $439,050; in 1903 it exceeded 22,000,000 barrels, while the value was over $27,000,000.

UNIVERSITY AND EDUCATIONAL NEWS.

The proposed affiliation or alliance of the Massachusetts Institute of Technology with Harvard University was approved at a meeting of the corporation of the institute on June 9. Thirty-two of the forty-seven members of the corporation were present, and by a vote of 20 to 12 it was agreed to accept the terms of the agreement recently drawn up by the committee of the two institutions. Before the agreement can become effective the corporation and overseers of Harvard University must take action and several legal questions must be passed upon by the courts. It will be remembered that on May 5 the faculty of the institute adopted by a vote of 56 to 7 the report of the committee adverse to the affiliation. A full account of the report adopted by the faculty and of the minority report, together with an account of the meeting of the alumni on May 4 has been published in a special issue of *The Technology Review*.

General William J. Palmer, of Colorado Springs, Col., and Mr. Andrew Carnegie have donated respectively $100,000 and $50,000 as a nucleus to the $500,000 endowment fund for Colorado College.

At the Commencement exercises of the Catholic University of America the rector, Mgr. O'Connell, stated that the university possesses, untouched by the Waggaman failure, assets and resources valued at $1,003,801. The bishops' collection ordered by the pope has resulted in $113,550 being turned into the treasury from 77 dioceses. A contingent fund of $200,000 has been raised since the Waggaman failure and has been invested in railroad bonds.

Earl B. Lovell, adjunct professor of civil engineering at Columbia University has been appointed director of the College of Civil Engineering, at Cornell University, as successor to the late Professor E. A. Fuertes.

Dr. Ralph Hamilton Curtiss, lately Carnegie assistant at the Lick Observatory, has been appointed assistant professor of astronomy at the University of Western Pennsylvania.

In accordance with the tutorial system adopted by Princeton University, preceptors with the grade of assistant professor have been appointed in the department of philosophy and psychology as follows: Professor R. B. Johnson, of Miami University; Dr. Adam Leroy Jones, of Columbia University; Professor W. T. Marvin, of Western Reserve University; Dr. Wilmon H. Sheldon, of Columbia University, and Dr. E. G. Spaulding, of the College of the City of New York.

The following appointments have been made in the scientific departments of the University of North Carolina: T. F. Hickerson, instructor in mathematics; J. C. Hines, Jr., assistant in physics; E. B. Jeffress and B. H. Perry, assistants in geology; W. H. Kibler, B. F. Royal, T. P. Cheshire, assistants in biology; E. E. Randolph, C. W. Martin, L. M. Kelly, G. L. Paddisson, assistants in chemistry.

Dr. James Bissell Pratt has been appointed instructor in philosophy and psychology, at Williams College.

Two fellowships of the value of $500 each, granted annually by the Woman's College of Baltimore, have this year been awarded to Miss Sabina Claire Ackerman, Easton, Pa., who will study chemistry at the University of Pennsylvania, and to Miss Sara White Cull, who will study biology at Columbia University. Other awards in science were as follows: The two scholarships at the Marine Biological Laboratory, at Woods Hole, Mass., to Miss Katie M. Brough, of Hanover, Pa., and to Miss Mary J. Hogue, of West Chester, Pa., both members of the graduating class. Three Woman's College scholarships, established at the Cold Spring Harbor Marine Laboratory of the Brooklyn Institute of Arts and Sciences, to Miss Ethel Nicholson Browne, Miss Hettie Cole Caldwell and Miss Maude Cecil Gunther, of Baltimore, members of the junior class.

Mr. Clarence Morgan (Harvard) has been appointed to the new chair of railway transportation at McGill University, and H. H. Mackay (Dalhousie) has been appointed assistant professor of civil engineering.

Mr. William Findlay, tutor in mathematics at Columbia University, has been appointed professor of mathematics at McMaster University, Canada.

Mr. A. R. Lord, B.A. Oxon., assistant to the professor of moral philosophy and lecturer on political science in Aberdeen University, has been appointed professor of philosophy and history in the Rhodes University College, Grahamstown, Cape Colony.

Mr. Edward P. Culverwell, M.A., fellow of Trinity College, Dublin, has been appointed to the new chair of education in the university.

SCIENCE

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FRIDAY, JUNE 23, 1905.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

*PLANT PHYSIOLOGY—PRESENT PROBLEMS.**

To the very year one century has elapsed since Theodore de Saussure published his remarkable investigations relating to the nutrition of plants and to the influences upon plants of certain well-known physical forces. Although preceded by the publications of Duhamel, Hales, Ingenhouss and Senebier, as well as by those in a somewhat different line, by Konrad Sprengel and others, we may look upon the work of de Saussure as a wonderful production for his time and as strikingly indicative of the status of plant physiological problems a century ago. His paper may be regarded in a sense as the original charter or constitution of plant physiology. Fortunately, it is assigned to an eminent and experienced botanical historian to recite the amendments which mark the wonderful growth of this historic instrument. There remains, therefore, the task of suggesting some directions of future growth.

No distinction need here be made between those problems which are readily seen to involve the closest work in such other sciences as physics and chemistry and those which do not show a relationship so close. There is certainly much in physiology which must be based upon physics and chemistry, but when dealing with the causes of the activities of living organisms, it is in relatively few cases that explanations may ever be offered in terms of

* Address read before Section C, Plant Physiology, International Congress of Arts and Sciences, St. Louis, September 22, 1904.

physics and chemistry alone. Nor is it possible to offer such explanations without the assistance of these sciences. The progress of the work in physiology is indissolubly bound up in the development of other sciences. The benefits are, however, mutual, and as physiology acknowledges the fundamental importance of these related sciences, they in turn must acknowledge the important contributions, often of fundamental nature, which have resulted through physiological investigation.

In such a paper it would be impossible to do more than outline briefly some of the relationships of special problems which, for one reason or another, merit emphasis. In general, the problems in plant physiology have been well brought out and systematized through the monumental work recently completed by Professor Pfeffer. To him the science owes a debt of gratitude which may be acknowledged as well by one who attempts to suggest future work as by the historian. Again, due recognition should be made of those who have in recent years based upon this or any similar topic valedictory addresses before various botanical organizations—notably, those of Professors Vines, Ward, Barnes, Reynolds Green and others.

The fact that every cell or organ requires its food materials, or at least its nutrients, in liquid form, readily emphasizes the fundamental importance of those problems suggested by the relation of the plant to solutions. The mechanisms for absorption and the general and special diosmotic properties of the living cell, all of which have been studied with the most consummate skill, have yielded matchless results; yet the rewards for future research show at present no distinct limitations. It has not been possible to determine the nature of the plasmatic membrane which directly or indirectly possesses such marked powers of selection and accumulation. The conditions under which the activities of this membrane may be modified are but poorly understood; and it is, perhaps, quite beyond the present possibilities to determine the mechanism of this modification, for in that must be involved one of the most important vital activities of protoplasm. Perhaps, when much more data have been accumulated by a study of plants of diverse habitat, the conditions of this modification may be more clearly distinguished. It is known that continued endosmosis of a particular solute depends largely upon the use or transformation of this solute within, yet it is not always possible to demonstrate any change in the substance absorbed. In any event, it is necessary to ask further light upon the exosmotic resistance of the plasmatic membrane to the accumulation of turgor-producing substances, or, in other words, to a further explanation of what may be termed one way penetration. To these phenomena the processes of excretion and secretion are closely allied, whether they are ultimately, periodically, or continuously the function of certain protoplasts.

Further chemical knowledge is needed dealing with the meaning of high pressures and of the accommodation of very high pressures in the fungi. As a rule, those protoplasts seem to be resistant to such high pressures which are also resistant to cold, desiccation and other stimulation. Mayerburg, working under the instruction of Professor Pfeffer, has recently applied himself to a study of the method by means of which the organism may regulate its turgor. It is evident that one of two propositions must be assumed, and that increased turgor may be produced either (1) by the penetration of substances from without, or (2) by substances of strong osmotic action produced within the cell through the stimulative action of external agents. It was determined in this case that in general no absorption of the substances bathing the plant occurs; therefore, osmotic substances are produced within the cell and largely by increased concentration of the normal organic cell products. The extent and method of this capability for turgor regulation are highly important, as is also the general question of the relation of turgor to growth. In recent times some of the important problems in this connection have been well suggested by the work of Rysselberghe, Puriewitsch, Overton, Copeland and Livingston.

The absorptive systems of plants seem to be admirably adapted for their needs from a diosmotic point of view. Diffusion may, therefore, be sufficiently rapid to supply all demands of the absorbing cells or organs. Nevertheless, the assumption that ordinarily diffusion through the cell and plasmatic membrane is sufficiently rapid properly to provide for the translocation of metabolic products from cell to cell is certainly open to further inquiry. Present knowledge of the translocatory processes is insufficient. Plasmatic connections between cells are now known to be of common occurrence, and this fact has given further interest to the above inquiry. Brown and Escombe are of the opinion that the plasmatic connections are eminently adapted for all of those phenomena which they have found to belong, as subsequently mentioned, to multiperforate septa. They claim, further, that with slight differences of osmotic pressure the necessary concentration of gradient for increased translocation would be very simply effected.

Thus far it has been difficult to throw any light upon cell-absorption and selection in many complex natural relationships by calling in the assistance of the dissociation theory and the ionic relationships of the salts in the soil. The external relationships of nutrient salts, or the relative abundance of these in substrata supporting vegetation, constitutes a problem with which the physiologist must be concerned. It is only necessary to glance at the results of work done by various experiment stations in this country to be convinced of the great physiological importance which may be attached to such studies.

Recent results tend to emphasize the importance of considering to a greater degree the physical conditions of the soil. Some have even gone so far as to claim that practically all soils contain a sufficient quantity of plant food; and that the all-important question is the regulation of the water supply in accordance with the quality of the particular soil. This latter, however, is an error into which few physiologists have fallen. Nevertheless, precise studies upon the relation of plants to the physical characters of soils afford problems which should receive the best attention. Many of the problems are not new, and in a qualitative way, at least, the problem of the relationship of the conservation of moisture and the tilth of the soil to productiveness has been duly appreciated by the best agronomists. We must notice with regret, therefore, that botanists have not always appreciated the importance of such work. Either directly or indirectly the water factor is a chief one in regulating the activities of the living plant and must be considered from every possible point of view.

It may, perhaps, be less a problem than a routine matter to determine the relation of the rate of absorption of salts in the soil solutions to water under the varying conditions of growth and transpiration. Nevertheless, information of this nature is important.

In spite of all the recent work, the physical explanation of the ascent of water in trees is a problem which must be mentioned. The renewed investigations which have been made along this line from an objective point of view will undoubtedly contribute to its eventual solution.

It is a matter of interest that in their studies of the physics of transpiration, Brown and Escombe have found evidence to regard this process also as a matter of diffusion through multiperforate septa, rather than a matter of mass action. It is calculated that by diffusion water may pass out of the stomates to an extent as much as six times the actual amount of transpiration which has been observed in special cases.

The great number of cytological investigations which have been completed within the past ten years indicate notable advancements in a most important field; and this is particularly true with relation to the study of nuclear phenomena. Through this work light has been thrown upon many problems of cell physiology and of development: and as a result of the latter new theories of heredity have been advanced. Nevertheless, the field for investigation has been constantly broadened and many new lines of research made possible. In spite of the excellent results accomplished, there is yet great uncertainty as to the interpretations which have frequently been made. In no field of work, perhaps, is it possible for the personal factor to enter into the results more largely than in this. Again, it is unfortunately true that fixed material has been studied almost to the exclusion of all other and that even general observations relating to the conditions of growth have been omitted in many instances. Much attention has been bestowed upon the minutest details which seem to be of morphological significance in the nucleus; but often the purely physiological side has been insufficiently emphasized. It is quite possible that in different plants, the exact method of chromosome division, or the manner of nucleolar disappearance, may not be similar; and it is certainly well known that external conditions may considerably modify the details of spindle formation, and perhaps other details in nuclear and cell division. The important point in every case is to determine if the same physiological purpose may be accomplished.

It is extremely important, however, to the subject of physiology that the methods which have made possible these cytological advances shall be extended and utilized in developing a knowledge of all of the various activities of the cell. In this way, a clearer insight may be given of many abstruse metabolic processes; and certainly further light may be thrown upon the matter of protoplasmic decompositions and secretions, the production of enzymes and alkaloids, tannins and other products. Going hand in hand with observations upon fresh material, the limitations of microchemistry alone should determine the possibilities in this direction of the work.

In such cytological investigations, Fischer's work on the artificial production of effects resembling those seen in fixed protoplasm should be borne well in mind. This work is timely, and may assist in checking irrational developments by forcing a proper regard for a comparison of the effects observed in fixed tissues with those shown by the living material.

There are, moreover, but few directions in which the study of metabolism and metabolic products may not profit from cytological research. A notable instance of what there is to be done is well indicated by the work of the late Dr. Timberlake on the division of plastids and the development of the starch grain.

Photosynthesis is a topic which has received a full share of physiological investigation throughout the past century; yet the problems demanding attention are too numerous for complete enumeration. The mechanism of gaseous exchange in leaves has repeatedly been experimentally proved to be the function of the stomates. After critical physical experimentation, Brown and Escombe have recently reported that the results of their studies of diffusivity through multiperforate septa are closely applicable to the herbaceous leaf with its stomates and substomatic chambers. Assuming their calculations to be correct, and granting that all of the incoming carbon dioxide is removed, it is estimated that with the stomates open the maximum observed rate of fixation of CO_2 in *Helianthus* (which is .134 c.c. per square centimeter per hour) would be only 5.2 to 6.3 per cent. of the theoretical capacity of the diffusion apparatus of the plant. In other words, with a gradient between the outer and inner air of only 5 to 6.5 per cent. pressure, the maximum observed fixation is well accounted for.

Important problems in the general study of photosynthesis may well begin with that of a better knowledge of the structure of the chloroplasts and the constitution of chlorophyll. Neither of these, however, is absolutely essential to further physiological observations of a fruitful kind. One of the questions long ago raised is still pertinent: what is the connection between chlorophyll and the plastid in which it is embedded? An answer to this question may perhaps afford in time an answer to the general inquiry as to the location of the true photosynthetic property. If chlorophyll is always the same chemically, it is perhaps probable that the first product of photosynthesis may always be the same, although this is not necessarily true. In any case, the chief problems hinge upon the method of decomposition of carbon dioxide and water and the synthesis of the first organic product. Neither the hypothesis of Bayer, Erlenmeyer, Crato, Bach, Putz, nor any other, has, to any considerable degree, been made capable of experimental proof, although that of Bayer has been most generally accepted. Each of these assumptions offers some suggestions for future work. Perhaps it may as well be said that they, to a certain extent, bias future research. Nevertheless, even when the chemical reactions in this synthesis become known it may yet remain problematical how the energy of sunlight, that is, of those rays most absorbed, with wave lengths of 660 to 680 μ is made available, or whether it is this energy directly or indirectly which is concerned in the decomposition. It has been well assumed that the light waves may not be immediately serviceable, but only after transformation into other forms of energy. Further, it is not known to what extent this energy is operative in subsequent transformations. The conditions under which photosynthesis occurs have been worked out with a fair degree of accuracy, the status of these problems having been well set forth by Ewart and others. It is known that when deleterious agents act at a given concentration merely to inhibit the assimilatory function (the cell not being permanently injured) there is no evident change in the chlorophyll, from which it has been inferred that the assimilatory arrest has its origin in the plasmatic stroma. In all cases photosynthesis can not long proceed except under conditions of health of the protoplasts. Nevertheless, the effects of deleterious agents have not always been studied by very delicate tests, and further attention might be bestowed upon this matter by the use of the photobacterial method, or other delicate methods, recently suggested, for it is of considerable interest to determine the relation of the photosynthetic activity to such agents as compared with other activities.

Recently the effects of temperature on photosynthesis have been carefully worked out by Miss Matthaei. She states that the curve of synthetic activity rises with increased temperature, that it is in general convex to the temperature abscissæ and somewhat similar to the curve of relation between temperature and respiration. There is a certain maximum for each temperature. It has also been ascertained that there is a certain economic light intensity beyond which there is no increased photosynthetic activity, and doubtless only injury. This is of special interest in connection with some recent work by Weis. Recognizing the fact that plants are of very different types with relation to their light requirements, he has sought to get an expression of their assimilatory energy. He finds that *Œnothera biennis,* a well-marked sun plant, fixes under favorable conditions of temperature, and in direct sunlight, about three times as much CO_2 as in diffuse light (light of one sixtieth to one ninetieth this intensity). On the other hand, *Polypodium vulgare* assimilates in diffuse light somewhat more energetically than in direct, while *Marchantia polymorpha* occupies a position intermediate. This will be welcomed by physiologists as a field for wholesome ecological study, for an extension of such investigations to an analysis of plant associations with relation to the light factor may yield profitable results.

In 1901, Freidel made the surprising report of success in securing outside of the living plant a gas exchange similar to the photosynthetic action of chlorophyll. He was later unable to confirm his previous conclusions, nor were the subsequent results of Macchiata and Herzog concordant. Recently, Molisch has employed upon this problem the photobacterial method of Beijernick. He finds that the expressed sap of certain plants may for a time maintain photosynthetic activity, but since usually the sap loses this power when filtered through a Chamberlain filter, it is believed to be due to the presence of living plasmatic particles. Nevertheless, it is claimed that an exchange of gases characteristic of photosynthesis may proceed in a solution of the leaves of *Lamium album* dried crisp at 35° C. and then 'rubbed up' in water and filtered. The observation demands much further study, for it must be remembered that the test is by means of the liberation of oxygen, and Ewart has shown that some bacterial pigments may have the power of evolving oxygen. In the last-named case the gas evolved appears to be, as he states, 'occluded oxygen absorbed from the air by the pigment substance excreted by the bacteria.'

It can not be stated at the present time, however, as was assumed from Freidel's first work, that there is any enzyme concerned in the photosynthetic activity.

To a large extent the problems involved in a study of the assimilation of nitrogen are limited by the very imperfect chemical knowledge of nitrogenous products, and may not, therefore, be very clearly defined. Practically, the whole question of the formation of amides, proteids or other nitrogenous compounds in plants remains in obscurity. It is known that these are formed in both non-chlorophyllous and chlorophyllous plants and that while in the former it may proceed in darkness, in the latter, light is apparently required for the most vigorous synthesis. In the latter case it may seem to suggest that there is need of the active cooperation of the chlorophyll apparatus; but here again the influence may be only indirect, since the roots, as well as the aerial parts of chlorophyll-bearing plants, are said to possess, to a certain extent, this synthetic power. Interesting suggestions have been recently made by Godlewski. The part played in photosynthesis by nucleus and cytoplasm, respectively, is unknown and may be important.

Some careful studies have been made dealing with the sources of organic nitrogen in certain of the molds, but owing to the very great variety of fungous habitats, further studies may indicate unusual specialization—perhaps even to such extent as is now known to be true with the bacteria.

Saida has confirmed and extended the early work of Puriewitsch and others, clearly demonstrating that under certain conditions some of the fungi are able to utilize to a variable degree the atmospheric nitrogen. It would be interesting in this connection to give further attention to various groups of saprophytic fungi. In a public lecture Moore has recently made known the results of remarkably definite experiments showing that the organism (or organisms) of leguminous tubercles assimilates free nitrogen apart from its hosts, and that, therefore, the symbiotic association gives the parasite no nitrogen-assimilating advantages. Moreover, this nitrogen assimilating capacity increases under conditions of artificial culture, and this increased power is heritable to a considerable extent at least. This is an important fact and deserves further attention.

Recently Reinke, Benecke and others have focused our attention upon the nitrogen supply in sea water. They find that the organisms *Clostridium Pasteurianum* and *Azotobakter chroococcum* are found in the ooze of sea bottoms; and the suggestion is made that the external but, nevertheless, close association of these micro-organisms with certain marine algæ may explain the power of these algæ to grow so vigorously in situations in which they are found. The nitrogen supply is probably one of the most important problems relating to the marine algæ. It is to be borne in mind, however, that the question of fundamental interest is always that of how these micro-organisms are able to utilize the nitrogen which is absorbed in gaseous state. No such power is known among phanerogams. It has not yet been demonstrated to be possible with the lower algæ, and certainly none of the interesting results so far obtained indicates that it is a very fundamental character of fungi and bacteria. In this connection, perhaps, it may also be stated that nothing whatever is known concerning the method by which carbon dioxide is chemo-synthetically utilized by the nitrite and nitrate bacteria.

There are many interesting problems afforded by the general phenomena of metabolism, with relation both to those products which may be immediately utilized and to those which may be stored up for future use. It is well known that during active growth special foods may be taken out of circulation and stored up. The stimulus to such storage is not easily determined. In many instances it is apparently the protoplasm which is decomposed in order that these storage products may be formed; therefore, so far as possible a study of all protoplasmic decomposition phenomena is especially necessary. The deposition of the cell plate and the storage of reserve cellulose are especially interesting. It will be extremely difficult to follow the succession of changes involved, yet some information will undoubtedly be gained.

The migration of compounds, particularly of those containing nitrogen, magnesium and potash, to growing vegetative parts and to the developing seed is most remarkable. The production, whether regulatory or otherwise, of the numerous by-products in the cell, such as tannin, pigments, organic acids, etc., is also of peculiar interest. The functions of some of these compounds must be most important, and should receive further attention. Tannin, particularly, is doubtless of much economic importance in the regulation of turgor and in augmenting the resistance to injurious external agents. Astruc has recently shown that acids are found in the younger parts of non-succulents and mostly in the region of maximum turgescence; and that there is a progressive decrease of such compounds in the older organs. In succulents, moreover, very slight changes in the external conditions materially affect the acid content.

It can not be expected that all of the information desirable with relation to the composition and action of hydrolyzing and oxidizing enzymes will be obtainable until more is known of the proteids, to which group the ferments seem to belong, or with which they are at least closely related. Whether these enzymes are concerned with the metamorphoses involved in rendering soluble or transforming pectin, proteids, glucosides, starches, cellulose, fats, or sugars, their physiological activities are in the highest degree remarkable, and worthy of the closest study. The problems which relate to their occurrence, composition, production and action require, however, the combined attention of physiologists and organic and physical chemists. In recent times, through the work of Brown and Morris, Fischer, Green, Prescott, Vines, Loew, Beijerinck, Newcombe, Woods, and many others, these compounds have received renewed attention. It may be that at present too many obscure phenomena are passed over with the superficial explanation that they are the result of enzyme action, and, therefore, require no further consideration. It is known that the ferments are largely concerned with the regulatory production of modification of numerous metabolic products. The activity of each enzyme is circumscribed, yet the power to do work borders upon the miraculous. It is asserted that invertin may invert 100,000 times its volume of cane sugar, and pepsin may transform 800,000 times its volume of proteids. The chemist is especially concerned with the composition and occurrence of these, but the physiologist is interested not alone in the occurrence and specific action of the enzymes, but also with the effects upon the general metabolism of the individual plant, with the methods and conditions regulating the secretion of these products, and with their vitalities or limiting external conditions. Ferments may be concerned with external cellular digestion, that is, with the solution and absorption of foodstuffs from without, thus necessitating exosmosis, or with intracellular modifications, preparatory to the direct use of the substances modified in metabolism or in translocation. Again, the ferments may be present only at a certain definite period in the life of a cell, produced, undoubtedly, by special requirements and special stimulation.

When isolated, or at least when outside of the cell, many enzymes are most active at temperatures far above those which may be maintained within the living cell. An explanation of this fact is difficult. Comparative studies of their reactions to light, heat, toxic agents and other stimuli should be made. In the penetration of parasites, cellulose-dissolving ferments are important, but further information is needed before it can be said that the presence or absence of such enzymes to any great extent affects the resistance of certain varieties and species to fungous attacks. It has been stated that the resistance of plants to fungus attacks is due largely to the presence of certain enzymes or toxalbumens present in the cells of the host; and by others it has been suggested that susceptibility is frequently a special property due to the presence of certain oxidases, which are regulated by external conditions.

It has been shown that the mosaic disease of tobacco and other similar diseases are accompanied by certain oxidase ferments which appear to prevent the digestion of reserve food. The ferment is developed in the growing parts of the plant, it may be transferred from plant to plant, and on the decay of the diseased organism, it is supposed to be set free in the soil. It is believed that it is then capable of diosmosis and infection of the young seedling. While it can not be shown at present that the enzyme is beyond all question the direct cause of the disease, this field of work is certainly one which might yield most interesting results. In this connection it may be stated that peach yellows and several other important contagious diseases are believed to be of somewhat similar nature. It is also claimed that the keeping qualities of fruits may bear a certain relation to the amount of enzymes present at the time of storage; and, therefore, a knowledge of the time and conditions of the production of such enzymes would have great economic value.

In general, Czapek found no enzymes to occur in the excretions from the roots of higher plants, and it is now generally believed that the roots of one plant may develop no excretions injurious to neighboring plants, and, therefore, there may be no biological relation between the roots of non-parasitic plants associated in the given plant society. It must be said, however, that the information at hand may not be taken as final. There are yet some peculiar facts with relation to the rotation of crops which may not be readily explained on the grounds of the exhaustion of plant nutrients or of the physical condition of the soil.

The fermentation of tobacco and tea, or hay and manure, involves enzyme actions which in recent times have received some attention, although the problems which are of most physiological importance require solution. The general belief is that in all cases of enzyme action these compounds do not form a part of the substance upon which their action is exerted, but they act as a key in each particular case, unlocking, or rendering labile, a certain organic compound, which is then subject to rearrangement and transformation. This is all, however, too speculative for profitable consideration, although such speculation may have no evil influence if it is not permitted to encourage the reference of all unusual phenomena to an unusually obscure and difficult process.

The early perfection of water culture methods permitted a careful study of the mineral nutrient requirements in the higher plants. Pure culture methods have afforded a more accurate means of studying the needs of fungi and certain algæ. As usually installed, water cultures of the higher plants contain bacteria, so that they afford only a practical test of the requirements. The problem demands some confirmatory tests, at least, under pure culture conditions, particularly when organic compounds are employed. It is possible to grow, in a limited way, higher plants under pure culture conditions.

With the fungi, exact studies may be made upon the influence of the different nutrients on the general form and upon the production of conidia, etc. It has been found, for instance, that, in the absence of potassium, *Sterigmatocytis niger* may produce no conidia or very curious modifications of the conidiophores. By far the most interesting problems with relation to the mineral nutrients are those which have to do with the rôles of these elements in metabolism. The effect of the lack of one or another element is made manifest by some general macroscopic change, and sooner or later, by disturbing pathological changes and subsequent death. It is reported, for example, that the absence of iron prevents the development of a healthy green color, and a scarcity of potassium is made evident, especially, in reduced photosynthesis.

We are yet merely at the threshold of these problems. A cytological and microchemical study of numerous plants in various conditions of culture is needed. Loew has instituted some good work in this direction. He attempted a careful microscopic study of *Spirogyra* under the conditions indicated. Although well rewarded, he has not followed up the result. The problem is, nevertheless, again under serious investigation, and when much time and thought shall have been devoted to it, with the utilization of the best cytological methods available, important results may be anticipated. The possibilities of the future are particularly dependent upon this, that investigation must be made of all macroscopic changes as well as of all demonstrable microscopic changes.

The interrelations of parasites and hosts, or of symbionts, are of such great physiological interest that some of the most significant problems may not justly be omitted in this connection. It has long been assumed that the conditions of nutrition of a host plant determine to a considerable extent its immunity to parasitic attack. Ward was unable to detect in the bromes any modification of resistance due to either high cultivation or to lack of sufficient mineral nutrients.

The results which have been attained with the Uredinaceæ have established the fact of the existence of 'biologic forms.' This opened a new problem in the study of the Uredinaceæ and it was later ascertained that similar host-restricted forms are present in other groups of the fungi, especially in the powdery mildew *Erysiphe graminis.* Salmon has found bridging host species by means of which the parasite may pass from one species or host to another; for example, the form of *E. graminis* on *Bromus racemosus* is incapable of affecting *B. commutatus,* but does not fail to affect *B. hordeaceus;* and the spores produced on the latter will then affect the previously immune *B. commutatus.* From infection studies it is further found that there are biologic forms among the grass hosts as well. Salmon reports that this restriction of the parasite to certain hosts may be broken down if the vitality of the leaf has been lowered by traumatic means. In this case penetration would result either in the injured area or certainly within the sphere of the traumatic influence. Spores produced by such infections proved capable of infecting uninjured leaves. The application of these results is certainly far-reaching; yet they must be extended and confirmed before a conservative explanation may be advanced. It is undoubtedly more or less in line with the well-known capacity of such fungi as *Botrytis, Nectria* and certain Basidiomycetes to become parasitic under special conditions. Two leading inquiries may be suggested: (1) What constitutes immunity or resistance in the host? (2) What constitutes virulence or attenuation in the parasite?

As the result of practical experiments in cross inoculation, on the one hand, and of close morphological study, on the other, some investigators have long claimed that there are racial or specific differences between the organisms producing the tubercles on the roots of certain leguminous plants. From the results obtained by Moore (in the U. S. Department of Agriculture) which have been reported, but not yet published, I am permitted to recite a further interesting fact of accommodation. When an organism isolated from one host species is grown for a time artificially, under special conditions of nutrition, its host limitations are in great measure broken down, and it may produce tubercles on a variety of leguminous plants. It is likewise conceivable that in the case of certain yeasts the temperatures at which spores are formed, and the specific fermentative activities, may be changed by special conditions of cultivation.

In view, therefore, of the work already accomplished it is certainly evident that the propriety of basing what are termed species upon certain physiological characters has distinct limitations. I do not intend to bring into this paper a discussion of the inadequacy of the present nomenclature system from a physiological point of view. It may be said, however, that it is scarcely possible for the systematist to consider all physiological characteristics, or to appreciate the confused ideals of the physiologist.

Stimulated by the marked advancement which has been made in physical chemistry, especially in the knowledge of electrolytic dissociation, the past few years have added much to our fund of information with relation to the toxic action upon plants of solutions of both acids and salts, as well also as of certain non-electrolytes. The work of Kahlenberg and True, Heald, Krönig and Paul, Clark and others has contributed enough data for an appreciation of the limitations of toxic action. Nevertheless, no broad generalizations are as yet possible. Indeed, it is not generalizations which are wanted, but further experimental data bearing upon the relation to the toxicity of the ions and molecules and their respective interactions.

Studies may well be made dealing with the relation of nutrition to toxic agents, the effects of temperature and other conditions upon such action, and the accommodation of organisms to increasing strengths of deleterious agents. Naegeli's work on the oligo-dynamic action of copper is beginning to be appreciated and in one way or another the results have in recent times been repeatedly confirmed. In most cases, however, no allowance has been made for the action of the nutrient salts which may be present in the culture fluid and which may affect in a very dissimilar way two different electrolytes. In this connection it is only necessary to call attention to the toxic action of certain compounds of mercury, in which increased toxicity, due to the presence of small amounts of some other salt of the same acid as the mercury salt used, is indeed quite remarkable. Within the past few months an unusually interesting paper has appeared in which Kanda reports the action of certain toxic agents upon plants grown in pots as compared with those plants grown in water cultures. His important conclusions are as follows: (1) A strongly dilute copper sulphate solution, even 0.000,000,249 per cent., is injurious to seedlings of the common garden pea in water cultures; and neither a solution ten times nor one a hundred times more dilute produced any stimulative effect. (2) In pot experiments with soil, the same seedlings are uninjured when watered twice a week during a period of from five to eight weeks with a solution of .249 per cent.; in other words, even after from five to seven grams of copper sulphate were present in each pot. No explanation is offered of this remarkable diversity of action, but within the past few months another paper has appeared which may throw light upon the results given. True has ascertained that finely divided paraffin, quartz sand, filter paper or other insoluble substances are all found to reduce the toxic action of the deleterious salt. It is explained on the assumption of an absorption of the toxic molecules by the surface of the insoluble particles. Increasing the number of grains of sand, for instance, in any toxic solution produced the same effect as increasing the dilution. From the results of these two papers it would seem, therefore, that we have two entirely different sets of conditions to deal with when any test of such action is made in water cultures, on the one hand, and in soils, on the other. If Kanda's results are confirmed, an extensive series of tests with both fungi and higher plants should be made in order to determine some relation which may give a working basis for further comparisons. In fact, much of the work thus far done will have to be reexamined in the light of these results, for if any precipitate or other solid particles have been present in the solutions, an error will enter into the calculations. The question will also arise if the surface extent of the vessel used in the culture is of any consequence. The practical bearing of these results in the treatment of soils is a matter which may prove of unusual economic interest.

Loew observed that marked injury results when such a plant as *Spirogyra* is placed in a solution of a magnesium salt, or in a solution in which magnesium is in excess. From all of the results obtained Loew has inferred that there is present in all plants requiring calcium an essential calcium protein compound. When magnesium must, owing to the predominance of this element, be substituted for calcium in this proteid compound there results a lessening of the capacity for imbibition, attended by unfavorable consequences. It has been further ascertained by the work of May, Kearney and Cameron, Kusano, Aso and others, that there is for each plant a certain more or less definite relation between calcium and magnesium. Nevertheless, further experimental proof is needed before this brilliant hypothesis may be acceptable in its entirety. It may here be noted that in a paper read by the writer before the Society for Plant Morphology and Physiology it is indicated that magnesium compounds exert upon the marine algæ the least injurious action of all nutrient bases. On the other hand, it has not been demonstrated that the marine algæ require calcium.

The general phenomenon of chemotaxy, or chemotropism, demands searching investigation in view of the recent work of Jennings on flagellates, that of Newcombe on root responses, and other studies on the fungi. There is much to be done in determining the effects of heat and cold upon special processes, in a study of the relations of temperatures to other conditions of the environment, and in showing the limitations of accommodation phenomena. In the latter study, moreover, the effects of accommodation upon the general constitution of the organism should be followed. Stimulation at high or low temperatures merely expresses an intensified or modified irritability. It may be observed in this place that death at the supramaximal or subminimal may be due to changes of a very definite nature; but as Vines has indicated, this means very little. To say that death at the supramaximal is due to the coagulation of an albuminoid as suggested by Kuehne is insufficient. For the immediate effect upon the protoplasm of this high temperature must also be of consequence. The external conditions of temperature of the effects of a modification of conditions are more or less readily determinable; but it has not been possible to follow the internal changes which result. It may be noted that the freezing point of a plant is lower than that of the expressed sap; yet of course the freezing point is not necessarily a valuable indicator of injury. The effects of temperature upon reproduction will be treated of later.

The symbiotic relationship of fungus and root to *Mycorhiza* offers a fine opportunity for careful investigation. The studies which have already been made serve only to put the reader in a state of hopeless confusion.

The universal phenomenon of irritability as manifested by trophic phenomena has been a fruitful field of investigation. The general methods of irritable response have been determined; and the best work of such investigators as Haberlandt, Noll, Czapek, Newcombe, MacDougal and others has more recently been directed to the deeper problems relating to the internal mechanism of response and to the exact methods of transmission of the stimulus, as well as to the immediate changes in the cells affected.

A word may be said concerning the regeneration phenomena which are strikingly characteristic of the lower groups of plants, but which in the higher plants do not seem to be well emphasized, and are certainly less understood. The regeneration of the root tip has been best studied. In none of the higher plants has it been possible from a single isolated active non-sexual cell, or a small group of cells, to regenerate the plant.

Although a study of the physiology of reproduction may be said to have had its origin in the early observations of Camerarius, all early studies represented largely only the ecological aspect of the subject. It is only in very recent years that rapid strides have been made in the general physiology of reproduction. The effect of conditions upon the production of antheridial or archegonial thalli or of pistillate or staminate flowers among diœcious and polygamous plants has received very slight attention. During the present year Laurent has published the results of experimentation during a period of seven years with the effects of fertilizers, or plant nutrients, upon spinach, hemp and *Mercurialias annua*. It will be seen that according to his results an excess of nitrogen or calcium has a tendency to produce staminate flowers in the spinach, while potassium or phosphorus tends to increase the production of pistillate flowers. The seed produced on the pistillate flowers of these plants gave a preponderance of female plants; but from these plants, in turn, the seed yielded a larger number of staminate plants. So far as I have been able to learn, it has never been determined if in a case of diœcious perennial plants it is possible by a change of conditions to induce a temporary or permanent change from pistillate to staminate flowers, or *vice versa*. In the same way, the influence of grafting or budding a scion of one upon the other has not been made out, although it is assumed that the flower will be characteristic of the scion.

It is with reference to the effects of external conditions upon the production of sexual and asexual fruiting organs that unusual progress has been made. In this direction a field of great magnitude has been opened by the work of Klebs, and it is evidently being pursued along all possible lines. As yet this work has been extended only to a few green algæ (as, for example, *Hydrodictyon* and *Vaucheria*); several fungi (*Sporodinia grandis* and *Saprolegnia mixta* especially); certain yeasts and bacteria, and finally, to several species of phanerogams. While with the algæ the light relation is of prevailing importance, with the fungi it is more particularly a matter of nutrition or transpiration. As a rule, with the latter Klebs finds the stimulus to reproduction in the failure of the food supply in the immediate vicinity of growth. That is, beginning with a well nourished mycelium a diminution of food supply, other conditions being constant, usually compels reproduction. A change in the specific chemical content may be effective, and in other cases there are other concurrent stimuli. In the study of phanerogams it would seem that the problem is one which is, as a rule, far more complex. It has, however, been found possible with a few species to produce at will continuous vegetative growth or continuous flowering, to induce fruiting in a well nourished vegetative shoot, and to incite vegetative growth in a flowering axis. It is probable that all shades of difference will be found in the capability of plants to have these processes distinguished by releasing stimuli; and it remains for the future to determine to what extent this is possible.

The general law which seems to be warranted is, that conditions most favorable for growth do not favor reproduction. The problem then is to determine for every organism what are these conditions under which, on the one side, growth, and on the other, reproduction, may occur. Whether, under any circumstances the complete cycle of development may be run without any change in conditions apparently awaits proof.

In grafting it would seem that seldom, if ever, do any characters of the stock pass into those of the scion except such characters as may be due to the presence of diffusible metabolic products, or products capable of self-propagation upon requisite stimulation. In this manner it has been shown that albinism may be transmitted from stock to scion. Again, Strasburger has indicated that atropin is accumulated in the potato when on a potato stock there is grafted a scion of *Datura stramonium*. It has been found that hardiness in the stock may affect the scion to a marked degree, but here the real problem is to determine what constitutes hardiness.

Fusion possibilities in vegetative cells are more or less common in all groups of plants. In basidiomycetes parallel filaments fuse under many conditions of development, and a pseudoparenchymatous tissue may result. In grafting, the layers which fuse may represent different species or even different genera. Little is known concerning the factors influencing such fusions. Allusion may also be made to the fact that plasmodia of the same species of myxomycetes (at least when produced in nearly similar conditions) fuse with one another. It should be accurately determined if this is an inherent property of the same race or species only, and if this fusion tendency may be weakened or dissipated by diversity of conditions under which the plants may be grown. The solution of such problems with simple and rapidly culturable organisms may even throw some light upon the more complex problems of self sterility and prepotence (in the sense in which these terms are used horticulturally) in higher plants—phenomena which may not be explained with present information. It has been found that tomato and tobacco fruits are sometimes formed without pollination; and the same is true of other plants. In certain cucurbits the act of pollination seems to afford a stimulus for the development of the fruit, even the dead pollen serving to call forth this response. Under such circumstances it may well be that other chemical stimuli may produce the same effect. On the whole, there are no more interesting problems in physiology than those relating to pollination, the penetration of the pollen tube, and conditions of fertilization. Many phases of these problems have thus far been studied by gardeners and horticulturists alone.

In this connection may be mentioned another fusion phenomenon of physiological interest—that of double fertilization in the angiosperms. This fusion of the second sperm nucleus with the endosperm nucleus (itself a compound of two nuclei of the gametic groups) or with one of the polar nuclei, may have a special significance, or it may be merely the expression of the fusion tendency which has not been lost, although the function of the endosperm nucleus may have undergone specialization. In the case of the pine, it will be remembered that the second sperm nucleus frequently undergoes division in the cytoplasm of the egg. What is meant by the fusion of the gametes? This is always a fundamental problem. It may be strictly a matter of the fusion of characters, or it may further be a stimulus to embryonic growth. It is a remarkable fact, however, that this stimulus to embryonic growth does not merely involve the embryo itself. The limitations of the correlations which seem to exist between the mere process of fertilization and incitation to growth in the extra-carpellary structures are extremely complex. On the other hand, the process of fusion is often immediately followed by the resting period.

It would be extremely well if further attention could be directed to the matter of parthenogenesis in the higher plants. Except in the case of Nathanson's studies upon Marsilia, little has been done to indicate the conditions which may induce or which may tend to induce this process. In recent years, artificial fertilization, or stimulus to a certain growth of the egg in the lower animals, has been effected by chemical agents, by changes in the density of the solution, and by other means. This work has demanded world-wide attention from animal physiologists. It has been too much neglected from a botanical point of view, although the difficulties involved in similar studies with plants would be, for the most part, immeasurably greater. Yet it is certainly possible to prosecute such studies along the lines indicated.

Except in the case of *Sporodinia grandis*, and perhaps one or two other species of Mucoraceæ, mycologists have experienced great difficulty in securing the zygosporic stage of these fungi. The recent paper by Blakeslee, announcing the conditions governing zygosporic formation in this family, seems to open a field for investigation wholly novel and suggestive. The substance of his results is that this family may be divided into two principal categories, designated, respectively, as homothallic and hetereothallic, these terms corresponding to monoecious and dioecious forms among higher plants. *Sporodinia grandis* belongs to the homothallic type, both gametes in every union developing from the same thallus. *Rhizopus nigricans* belongs to the second and larger class, the hetereothallic type, in which the two gametes are invariably the product of two mycelia, which mycelia are sometimes of diverse vigor. When in culture, the two strains, as they are termed, grow together, zygospores are abundantly produced along the lines of contact. These are the striking results of this important paper; but other related physiological facts have been observed, and only further investigation can tell whether this is a special case of gametic union in the fungi, or whether similar phenomena may be found to be characteristic of other groups where there is gametic union.

The discovery of Mendel's hybridization studies and the independent confirmatory evidence furnished by de Vries, Correns and others all indicate the necessity of differentiating unit characters and of following separately the inheritance of each unit character. The idea which it involves of the purity of the gametes with respect to unit characters, the segregation of unit characters in the formation of the gametes, is one of fundamental importance. Such work has given a marvelous impetus to studies in inheritance. Numerous investigators have followed up this work, but it will be many years, perhaps, before a test of the Mendelian laws can be carefully made with any great number of plants and animals. The exceptional instances already reported of the appearance of mosaic characters and the dissimilarity in the product of reciprocal crosses themselves indicate further fields for experimental research. Only a word need be said bearing upon the phylogenetic side of physiological work, since phylogeny, as well as pathology or ecology, constitutes a separate section of biological science. The admirable work accomplished by de Vries, serving beyond all question to demonstrate experimentally the origin of species by leaps or mutations, necessitates laying further stress upon discontinuous variation as a factor in the origination of existing species of plants. It is to be doubted, however, that most botanists will at present concur in such an opinion as that the evidence advanced is sufficient to disregard or disparage the part which is played by continuous variation in the origination of species. Continuous variation must be manifest by relatively slight variations; and it would be unfair to expect at this time the experimental proof of its efficiency. It may even be assumed that there is a complete series between continuous variations and discontinuous variations, as well, perhaps, as between the possibilities of inheriting immediately or ultimately such variations. Many of the problems in plant physiology are distinctly practical problems. The task of the physiologist is primarily to study the activities of plants irrespective of practical bearing. To have the greatest possible breadth and force, however, the cultivated plant may not be neglected in any of its artificial environmental conditions. It is unfortunate that as yet physiological botany has not been made fundamental to agronomy, horticulture, forestry and other sciences, arts or commercial pursuits. Physiology can not be limited by any practical problems, nor can any sacrifices be made, but a sympathy with commercial endeavor will invigorate the work, will afford equipment and will contribute towards the common good.

In conclusion, it may be said that present-day physiology, even more than any other section of biological science, is fundamental. Many phases of pathology, ecology, phylogeny and experimental morphology, especially, may not be clearly differentiated as sections. Broadly conceived, plant physiology concerns itself:

1. With the relationships of existing organisms, ontogenetically and phylogenetically. Phylogeny would necessarily claim much of this general field, as would also morphology, ecology and other subdivisions.

2. With the functions or activities of organs, tissues and cells, and the interactions and interrelations of these one with another and with external forces. It is here that morphology touches physiology

most closely and here experimental morphology must have its basis.

3. With the incorporation and excretion of matter, metabolism and growth, the sources and uses of energy, irritability, and the minute constitution of living matter. In this last are included many of the most fundamental problems, not necessarily problems involving the question 'What is life?' but problems concerned with the resolution of those factors and an intimate knowledge of those materials which make life possible.

BENJAMIN M. DUGGAR.

SCIENTIFIC BOOKS.

THE BAHAMA ISLANDS.*

This handsome volume on the Bahama Islands is of merit in two regards. It is an appropriate expression of the energetic initiative of its editor in developing an interest in geography in Baltimore, and it is a serious scientific study of a peculiar group of islands.

Professor Shattuck offered a course of lectures on physical geography to the teachers of Baltimore several years ago. The course proved attractive and was well attended; it was followed by an association of the teachers for more lectures and for field excursions under Shattuck's guidance. This association was soon succeeded by the organization of the Geographical Society of Baltimore under the presidency of D. C. Gilman and the direction of a distinguished board of trustees. The membership in the society rose to something like 1,500 in its first year of existence. Its objects were to place before the public of Baltimore an annual course of lectures dealing with geographical subjects, to foster geographical research, and from time to time to publish monographs of geographical investigations. All these objects have now been realized; hence although the activity of the society has been sadly interfered with during the past year by the disastrous conflagration of 1904, the secretary, as director and editor of the Bahama expedition, has had so notable a success in bringing out a monographic volume on the first investigation undertaken by the society that we confidently expect a revival to full activity in due time, and a vigorous continuation of the work thus begun.

Shattuck having made a preliminary visit to the Bahamas in 1902, the expedition of over twenty members left Baltimore June 1, 1903, in the *Van Name,* a hundred-ton schooner, provisioned for a two-months' cruise, and with an equipment to which the governmental bureaus at Washington and the Johns Hopkins University had contributed. The results of the expedition are now set forth in sixteen chapters by nearly as many authors. Shattuck and Miller describe the geology and physiography of the islands; Dall discusses the fossils and the non-marine mollusks; Fassig reports on magnetic and climatic observations, and Shidy on tides. The soils are elaborately classified by Mooney; Coker describes the vegetation, and Coffin tells of the mosquitoes. The fishes, birds, reptiles and mammals are reported on by Bean, Stejneger, Riley and Miller; the sanitary conditions by Penrose. The longest chapter is a history of the islands by Wright, and the volume closes with some general geographical considerations by Shattuck. The illustrations are numerous and good.

Earlier observers have shown that the Bahamas consist of 29 islands, some of which are mere skeletons or strips of land, with numerous small keys and rocks, in all some three thousand in number, rising from a shallow submarine platform or plateau, which in turn stands up rather abruptly from the deep ocean floor. The material of the platform as far as known and of all the islands is altogether calcareous, of shell and coral origin, worked over by waves and winds. On the islands the rock is weathered into a ragged and pitted surface; its texture is so weak that it is sawed or chopped into blocks for house building. The area of the islands is but a fraction of that of the platform, partly be-

* The Geographical Society of Baltimore. The Bahama Islands. Edited by George Burbank Shattuck, Ph.D., associate professor of physiographic geology in the Johns Hopkins University. New York, Macmillan. 1905. 630 pages, 93 plates, 7 figures.

cause of submergence from a time of a more continuous land surface, partly because of shore erosion, which goes on furiously during autumnal hurricanes. The submergence is inferred to have amounted to 300 feet, because the islands are honeycombed with caverns, of which the deeper ones descend 300 feet beneath present sea level.* Observations by the geologists of the expedition indicate that the submergence of the islands has recently been somewhat greater than now, for stratified deposits containing fossils of living marine species are found at altitudes of fifteen or twenty feet at many places. Whether the islands are now rising or sinking is not asserted, but the bench marks that were set up and carefully measured with respect to sea level will make it possible to answer this question within a few score years.

The shallower parts of the submarine platform are so thickly studded over with coral reefs that it has proved impracticable to chart them. At certain points the platform is pierced with 'ocean holes,' or areas of deep blue water in the midst of the shallower green sea. Here the tide ebbs and flows through sub-platform passages; in one instance that is described a descending eddy was noted, with concave surface and foaming center. The tides were carefully observed at Nassau and thus better determined than ever before for these islands; they are shown to be of the Atlantic type, that is, with two subequal high tides in each lunar day; and not of the Gulf type, in which, as a rule, only one tide occurs each day. The mean tidal range is 2.634 feet, with spring and neap means of 3.051 and 2.129 feet; the mean lunitidal interval or corrected establishment of the port is 7 h. 22.8 m.; but the variation of this interval due to priming and lagging may amount to 45 minutes. The well-known uniformity of the Bahaman climate is attested; even in early summer, temperatures of 80° or 90° were not oppressive, the air being moderately dry and usually in motion. Flights of kites and observations on clouds indicated a diminution in the velocity of the prevailing easterly trade wind above 4,000 feet altitude, a curious contrast to the conditions obtaining in temperate latitudes where an increase of velocity with height is the rule.

The soils of the islands are described in greater variety than one might expect on a foundation exclusively calcareous, seven types being recognized. The most important are the black loam and the red loam. The former occupies about three fourths of the surface, and makes what is known as 'provision land,' because of its use for subsistence crops. It is good for citrus fruits, among which the shaddock or grape fruit takes the lead; but this soil is so thin that when fruit trees are planted, a hole is first blasted in the underlying rock. Sisal, which is destined to be an important product, and cotton, more important formerly than now, also grow in this soil; the cotton plant grows tree-like, living over several seasons and having to be pruned to keep its branches within reach. The red loam soil is the best for pineapples, a very important crop, as over seven million dozens were exported in 1902, yielding almost $200,000; but the prices have fallen in recent years, partly on account of the poor treatment of the pineapple in marketing it. The receipts from this source are at present much exceeded by those from sponges.

We shall pass rapidly over the biological chapters. There is an elaborate list of plants,

* This line of argument is in accord with current geological opinion, yet it does not appear to be altogether proved that submarine caverns may not be dissolved out by fresh-water streams which descend beneath the level of the sea and rise again to the sea floor; just as caverns are conceivably formed beneath the level of the ground-water table on the land. Many land caverns now above the water table are filling with calcareous deposits; the excavation of such caverns by solution may have taken place before the neighboring valleys were worn to their present depth, or when the region stood at a lower level, so that the cavern zone was beneath the water table, and the growing cavern was filled with water. Whether the cavern zone was beneath the land or beneath the littoral sea floor is immaterial, so long as the ground water is kept in motion. Is it not indeed possible that the excavation of some submarine caverns was begun as well as continued by the tidal currents now flowing through them?

950 species of native and naturalized forms being noted, including seven indigenous palms, several figs and thirty orchids. Many species are shared with the United States, but most of our deciduous forest trees are wanting. The important geographical element of distance shows its effect in the less number of continental plants in the southern than in the northern islands. Although the yellow fever mosquito was found, thus making a properly screened quarantine desirable at Nassau, the absence of *Anopheles* indicates that, from the standpoint of malarial diseases, the islands are a good health resort; on a later page, the islands are described as favorable for consumptive cases also. The only marine forms described in detail are fishes; these are noted as having a popular interest for the tourist because of their extraordinary colors and forms, well seen when watched through the floor of a glass-bottomed boat. Of reptiles and batrachians, no less than 22 out of 35 species and subspecies are restricted to the islands. Forty-four endemic species of birds, out of a total of 204 species and subspecies, are described in detail in their bearing on the derivation of the Bahaman avifauna. Only eight mammals are found whose presence is not certainly due to man; these include rats, mice, the rat-like hutia, raccoons and bats.

The chapter on sanitary conditions is of unusual and pitiful interest. Some of the islands have only white inhabitants; some have nearly all blacks; others are variously mixed as to race. The island of New Providence, on which Nassau is situated, has a well-civilized mixed population; the island of Andros, the largest of the group, has a relatively barbarous population of blacks. The islands of only white population have many degenerates. At Hopetown there has been an excessive amount of intermarriage, and although the original stock was good, the present condition is deplorable, the climax being found in a family of eight children, of whom five are idiots. An instructive genealogical tree is given in connection with this case. Leprosy is not uncommon, but except at Nassau there is no isolation of those suffering from this dread disease. The expedition was provided with an excellent medical outfit, and at each town a free dispensary was established during the stay there. The people were timid at first, but after gaining confidence they came in throngs; when the party had to return to the schooner, it was with difficulty that the outfit was packed up, and a way forced through the crowd; the more determined invalids followed on boats, climbed on board the schooner and begged to be cared for. A special account is given of the most important diseases met with.

The chapter on the history of the islands is a book of 160 pages in itself. After brief description of the early buccaneering days, special attention is given to the problems of slavery, with sufficient indication of the wretched treatment that too often occurred, and little illustration of the obsolete argument that the conditions of the blacks was then better than under freedom. Yet to-day the condition of the people must certainly be low, for one of the governors, recently appointed by the crown, thinks that there is not enough good material in the islands to provide the twenty-nine members of the legislature which is to share the government with him. "What is wanted here," says the governor, "is a system based on that so ably conducted by Mr. Booker Washington, at Tuskegee, Alabama, United States of America, and until that or some similar scheme based upon industrial training as the main factor in the educational method is adopted, I fear that no improvement in the condition of the large native population in this colony will be manifested." In view of all this, one must conclude that the islands, with their mild and attractive climate and the beauty of their oceanic setting, must, nevertheless, be taken as illustrating the unfortunate and depressing consequences of monotony and isolation.

W. M. D.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 602d meeting was held May 13, 1905.

Mr. L. W. Austin read a paper on 'The Specific Heat of Gases at High Temperatures,' describing experiments made by Professor Holborn and himself at the Physikalisch-Technische Reichsanstalt during the years 1903–04, with the object of bridging the gap in our knowledge of the specific heat of gases between 200° and 1000°. Below 200° we have the experiments of Regnault and others, while between 1000° and 2000° we have the explosion experiments. Regnault and his co-workers found the specific heats of the simple gases independent of temperature, while Mallard and Le Chatelier have concluded that the specific heats increase with temperature. The method of mixtures at constant pressure was employed, the gases being heated in an electrically heated nickel tube filled with nickel filings, according to the method of Wiedemann, and the heat being taken up in the calorimeter by small silver tubes filled with silver filings. The temperature of the hot gases was measured by a platinum/platinum-rhodium thermoelement at the point where the gases entered the calorimeter. After leaving the calorimeter the gases were caught in a gasometer at atmospheric pressure, the volume being measured by means of the displaced water. The gases did not come into direct contact with the water but were caught in a rubber bag, so experiments were possible with the more easily absorbed gases. In Table I. the results for the simple gases, and oxygen, nitrogen and air, are given. These indicate an increase in the specific heat of about three per cent. for air and nitrogen between 20°–440° and 20°–800°. However, as the limit of accuracy is hardly better than ± 1 per cent. the observed difference but little exceeds the possible errors of observation. The results for carbon dioxide are given in Table II. compared with those of Regnault, Wiedemann, Mallard and Le Chatelier, and Langen.

Table I.

Between.	N.	O.	Air.
10–200°	(0.2438)*	(0.2175)*	(0.2375)*
20–440°	0.2419	0.2240	0.2366
20–630°	0.2464	0.2300	0.2429
20–800°	0.2497		0.2430

Table II.

	Regnault.	Wiedemann.	Mallard and Le Chatelier.	Langen.	Holborn and Austin.
0°	0.1870	0.1952	0.1880	0.1980	0.2028
100°	0.2145	0.2169	0.2140	0.2100	0.2161
200°	0.2396	0.2387	0.2390	0.2220	0.2285
400°			0.2840	0.2450	0.2502
600°			0.3230	0.2690	0.2678
800°			0.3550	0.2920	0.2815

* From Regnault.

Mr. A. L. Day described 'An Interesting Pseudosolid.' It was a fine foam made of Plateau's solution or white of egg and sugar. Cylinders cut from this showed elastic properties like a solid but through a wider range and a fracture, photographs of which appeared like marble fractures. Since the dimensions of the cylinder under stress could not be measured directly photographs were used; the results were consistent to one half per cent. Poisson's ratio came out nearly .50. He also detailed the results of experiments on 'The Linear Force of Growing Crystals.' Thus, an alum crystal raised a weight of 1 kg. per sq. cm. through several tenths of a millimeter; the growth takes place only at the lower edges and the area of the supporting edge is too small to measure with accuracy; the forces are of the order of other molecular forces, and are quite sufficient to produce and enlarge fissures in the rocks. Both investigations have important bearings in geology.

President Littlehales then read a biographical sketch of the late David Smith, chief engineer in the navy (1834–1903); his most notable services were in standardizing naval equipment and in improving the ventilation of ships.

Charles K. Wead,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The eighth meeting of the club for the year 1904–5 was held on Thursday, May 18, at 7:30 p.m., in the physical lecture room, Science Hall.

The first paper of the evening, by Professor J. L. Bartlett, dealt with the subject, 'The Influence of the Madison Lakes on Local Air Temperatures.' The speaker showed that through the influence of the lakes, which cover one third of the total area within a radius of six miles from the university, the growing season at Madison is appreciably lengthened. It was shown by comparisons with the average data for four neighboring stations, which have strictly continental temperature conditions, that there is an average departure from local continental types of from 0 to — 3 degrees in the mean maximum temperature during the various months of the year, of 0 to + 4 degrees in the mean minimum temperature, and an increase in summer and autumn in the mean monthly temperature, and a decrease in spring.

The subject of the second paper of the evening, by Professor C. S. Slichter, was 'The Underflow of the Arkansas River.' The speaker presented the results of an investigation conducted last summer under the auspices of the United States Reclamation Service of the region covering the drainage basin of the Arkansas River from Garden, Kans., westward to the state line. The work done indicates that the water of the Arkansas underflow has its origin in the rainfall upon the sand hills to the south of the river and upon the bottom lands and plains to the north of the river. The rate of movement of the underflow was found by the electrical method to vary between eight and eleven feet for twenty-four hours. It was shown that the Arkansas River contributes water to the underflow in time of flood. When the river was high a movement of the ground water away from the river channel was measured and found to be about eight feet for twenty-four hours.

The following members were elected officers of the club for the year 1905–6:

President—Professor Louis Kahlenberg.
Vice-President—Professor C. K. Leith.
Secretary-Treasurer—Professor Richard Fischer.

F. W. Woll,
Secretary.

THE SAN FRANCISCO BIOLOGICAL CLUB.

A meeting of the recently organized San Francisco Biological Club was held on April 22, 1905. The following papers were presented:

President David Starr Jordan: 'Actual Origin of Species.'

Professor Jacques Loeb: 'On Artificial Parthenogenesis.'

Professor G. J. Peirce: 'Irritability in Algæ.'

Professor J. B. MacCallum: 'On the Diuretic Action of Certain Hæmolytics.'

Dr. F. W. Bancroft: 'On the Validity of Pflüger's Law for the Galvanotropic Reactions of Paramœcium.'

Dr. P. Olsson-Seffer: 'Seed-transport by Oceanic Currents.'

Dr. Harold Heath: 'The Development and Significance of the Body-cavity in Certain Invertebrates.'

Professor J. C. Merriam: 'Adaptive Radiation in the Early Reptilia.'

Professor C. A. Kofoid: 'On the Structure of some Pelagic Ciliata.'

Professor W. A. Setchell: 'Regeneration in Kelps.'

Professor W. J. V. Osterhout: 'Polarity in Plants.'

W. J. V. Osterhout,
Secretary.

THE PSYCHOLOGICAL CLUB OF CORNELL UNIVERSITY.

The session of 1905 has been devoted to the consideration of experimental studies of memory and economical learning. The following papers have been read:

Professor Titchener (two papers): 'The Work of Ebbinghaus.'

Professor Bentley (two papers): 'The Work of Mueller and Schumann.'

Mr. H. C. Stevens (two papers): 'The Work of Mueller and Pilzecker.'

Miss E. Murray: 'The Importance of Repetition.'

Mr. J. H. Coffin: 'Learning by Whole and Part.'

Dr. T. de Laguna: 'The Distribution of Repetitions.'

Mr. R. B. Waugh: 'Economy of Learning, I.'

Mr. S. P. Hayes: 'Economy of Learning, II.'

Mr. A. C. Muhse: 'Economy of Learning, III.'

Mr. G. H. Sabine: 'The Trend of Investigation: Problems and Methods.'

DISCUSSION AND CORRESPONDENCE.

AN AUTOMATIC CATALOGUE OF SCIENTIFIC LITERATURE.

To the Editor of Science: The cataloguing of current scientific literature is receiving considerable attention at the present time. The difficulty of accomplishing this with promptness and completeness is well shown in the first annual issue of the 'International Catalogue of Scientific Literature' comprehensively reviewed by Professor H. B. Ward, in a recent number of Science.

The spectacle of four organizations employed in practically the same work, viz., the cataloguing of zoological literature, and all the catalogues found to be incomplete when carefully scrutinized in any particular line, would seem to demonstrate the futility of hopes for a complete catalogue in a system where the cataloguers are compelled to collect and review the literature.

For a catalogue of scientific literature to be of great value it should enable a writer to feel that justice has been done his predecessors when the literature catalogued under any subject in question has been canvassed, and this will not be the case if there is even a doubt as to completeness. On the other hand, a catalogue, in which confidence was justified, would save an enormous amount of labor and greatly increase the efficiency of the world's investigators.

The character of the publications in which the results of scientific work appear are so diverse and difficult of access, and the amount of literature to be catalogued is really so large that any approach to absolute completeness by the means now employed seems out of the question, even with the most liberally endowed organization.

It seems clear to the writer, at least, that the desired result can be obtained only by some scheme in which the authors themselves are responsible for the cataloguing.

In scientific work the class that writes is, to a large extent, the same as that which consults the literature and it would seem only just that those wishing to use the work of others should be willing to make their own work accessible. Scientific etiquette now demands that articles be published under reasonably short and appropriate titles, thus assisting the cataloguers in their enormous undertaking. May it not be possible to carry this a step further?

Let it be considered a necessary part of the publication of an article, that the title, at least, and an abstract, if desired, be submitted to the cataloguing organization. The labor of that body would then be confined to editorial work and could be accomplished by a comparatively small staff. The abstracts would convey the ideas of the authors and the interest which every writer takes in his own work would insure the completeness of the catalogue. It would be necessary to establish a maximum ratio between the length of the article and the length of the abstract. The general classification of the subjects would need to be made public and the authors should indicate under which branch they wish their work to be catalogued, it being allowable to catalogue a title under more than one subject-head with cross-references to the place where the abstract appears.

The title and abstract should be submitted simultaneously with the appearance of the publication; thus the catalogue could be complete to date of issue. This feature would also be entirely automatic, as it would be to every author's advantage to have his work placed before the public as promptly as possible.

Any scheme of this kind will appear to many as fanciful. Whether this charge be just or not depends entirely on the way in which the scheme is launched.

If simultaneously adopted by the large scientific organizations its automatic nature would insure its success. If put into operation prematurely by any organization that does not command the support of the scientific public its failure is no less certain. Indeed, an attempt of similar nature was made not long since by an obscure institution whose prospectus received little or no attention, other than that aroused by the fantastic English in which it was couched.

G. N. Collins.
U. S. Department of Agriculture.

'LIFE AND CHEMISTRY.'

To the Editor of Science: The interesting address of Professor Charles Baskerville, entitled 'Life and Chemistry,' published in Science, Vol. XXI., No. 539, contains a statement which calls for review. He says that "Seed, one of the means of nature's reproduction, may remain years, centuries, in vaults, as within the Egyptian pyramids. When subjected to the proper conditions, they sprout and reproduce." What are the 'proper conditions' for the germination of these mummy seeds? DeCandolle, and others, experimented with seeds in many ways, and were unable to prove that they possessed such remarkable longevity as that referred to in Professor Baskerville's address. Their germinating experiments indicated that few seeds retained their 'vitality' after ten to fifteen years. They appeared to believe that thirty years was the limit of longevity in the most vigorous seeds.

Seeds collected from mummy cases, and reported to have germinated, are regarded by many botanists as 'salted.' This view regarding the short longevity of seeds is current in botanical literature. If that literature is incorrect it should be revised.

M. A. Brannon.

SPECIAL ARTICLES.

THE IDEAS AND TERMS OF MODERN PHILOSOPHICAL ANATOMY.*

The ideas of philosophical anatomy have been developed during three periods of human thought: First, the Greek, in which adaptation was clearly perceived as the central phenomenon of life, in its morphological and physiological expression. Second, the pre-Darwinian period, in which ideas of the environmental relations were developed especially by Bacon; and various forms of morphological, physiological and especially psychical adaptation were developed gradually through the studies of Buffon, Lamarck, Geoffroy, St. Hilaire and more especially Goethe; adaptations began to be distinguished broadly into *primary*, or those which had been of use in past time, and *secondary*, or those which were recent in origin and in full use at the present time. Even prior to these writers, however, Vesalius in his studies of human anatomy perceived the importance of this distinction. Philosophical anatomy really owes to Darwin himself the fundamental ideas which are involved in the terms primitive, retrogressive, progressive and dominant, and are now understood with perfect clearness. This is the third period of anatomy as established on evolution. Huxley in his brilliant essay of 1880 on 'The Laws of Evolution as Applied to the Mammalia' was the first to emphasize persistent primitive characters and modernized or adaptive characters, laying great stress on the importance of the former in questions of phylogeny. Among many other anatomical papers E. Ray Lankester's 'Degeneration, a Chapter in Darwinism,' brought out especially the significance of retrogressive changes.

Huxley was a master of logic, but even his keen vision failed to recognize the vast importance of the element of analogy, or similarity of function, in bringing about a similarity of structure in evolution independent of real similarity of kinship. This final phase broad extension of paleontology, and the demonstration over and over again in nature that similar forms have been produced independently either by parallelism from animals related in ancestry, or by convergence in animals unrelated in ancestry. To these processes and results of similar modeling Lankester has applied the fitting terms homoplasy and homoplastic.

In the table an attempt is made, for the first time to my knowledge, to bring together all these processes of change and to indicate their interrelations. There can be little disagreement as to the terms in columns I., II., III., but some surprise may be felt as to the broad inclusiveness of column IV. The justification for this column lies in the fact that in the analysis of any animal form the questions which each anatomist should put to himself as regards each character are: Is this a primi-

* Presented before the New York Academy of Sciences, by Henry Fairfield Osborn, April 10, 1905.

THE IDEAS AND TERMS OF PHILOSOPHICAL ANATOMY.

I.	II.	III. (Comparison)	IV. (Comparison)	V. (Comparison)
Life is the continuous adjustment of internal and external factors and processes. Adaptation is of the broadest character and relations, internal and external, including:		In every animal adaptations of the past, present and future mingle, and may be broadly distinguished into:	AS REGARDS PRESENT TIME. Animal and plant types, organs and functions are accordingly found in all grades of development and adaptiveness, with reference to past, present and future activity.	AS REGARDS ORIGIN. The results of adaptation in different animals and plants are also comparative, *i. e.*, similar, or dissimilar, according to the operation of similar internal (*i. e.*, hereditary) and environmental conditions.
ENVIRONMENTAL OR BIONOMIC, *i. e.*, in relation to physical and living surroundings, to geologic, geographic, physiographic, meteorologic, faunal and floral conditions or changes.	ADAPTATION AND ADAPTABILITY.	PRIMARY OR PRIMITIVE.	1. *Primitive.* 'Persistent primitive,' or arrested types, organs and structures which continue to be useful although perhaps of very great antiquity, resulting from the balanced or stationary, also 'progressive' and 'retrogressive' condition.	I. HOMOLOGOUS, *i. e.*, *Homogenous.*
MORPHOLOGICAL OR ANATOMICAL, *i. e.*, structural, in organs, direct or correlated. PHYSIOLOGICAL OR FUNCTIONAL, *i. e.*, in habits and uses of organs. PSYCHICAL AND NEUROLOGICAL in the brain, nervous system, and psychic life generally, imitations, instincts, intelligence.		SECONDARY OR ADAPTIVE.	2. *Retrogressive.* Declining types, organs, habits and functions. Reduced, degenerating, partly functional, and functionless, passing through the stages of 'regressional,' 'vestigial,' 'variable,' 'atavistic,' or 'reversional' (according to certain percentages of occurrence) into 'recessive' (*i. e.*, very rarely reversional). 3. *Progressive.* Rising or developing types, habits, organs and functions. Rudimentary, prophetic or nascent organs and structures in the true sense of beginning, becoming sub-functional, then functional or fully useful. 4. *Dominant.* Organs, etc., attaining such importance as to overshadow all others, often leading to the extinction of the types through extreme specialization.	II. ANALOGOUS. *Parallel.* Analogous adaptations, *i. e.*, similar characters arising independently in *similar or related animals or organs*, causing a similar evolution, and resulting in parallelisms. *Convergent.* Similar adaptations arising independently in *dissimilar or unrelated animals or organs*, causing a secondary similarity or approximation of type, resulting in *convergence.*
		TRANSITIONAL.	1. *Modifications.* Somatic changes, environmental, also use and disuse, in part germinal. 2. *Fluctuations.* Germinal, fluctuating changes of degree, continuous. 3. *Saltations.* Germinal, marked changes of kind, sports, mutations of De Vries, discontinuous variations. 4. *Rectigradations.* Continuous germinal changes in a single direction, mutations of Waagen.	III. NON-ANALOGOUS. *Divergent.* Increasing specialization and differentiation resulting in 'divergence' or 'adaptive radiation.'
	The collective phenomena of fitness and the evolution of fitness as the essential and distinctive feature of life.	Fitness in time, *i. e.*, in past time, in the present, and tending toward fitness in the future.	Grades or degrees of fitness as determined in *individuals* by direct study or comparison, in the sciences of anatomy, comparative anatomy, paleontology, embryology, in ontogeny, fetal and larval life.	Fitness of certain groups or organs in comparison with *other groups* (*i. e.*, classes, orders, families, genera, species, varieties) as well as in comparison with organs and functions in other groups of animals.

tive or a secondary character? If primitive, is it in a balanced or stationary condition, or is it in process of change? Secondly, is this a retrogressive or a progressive character? Questions to be answered certainly only by the evidence afforded by ontogeny or paleontology, and in a comparatively limited number of cases by comparative anatomy. Further, it may be necessary to ask: Is this a dominant character, or one which has attained such importance in evolution as to crowd out and overshadow all others?

Anatomical analysis, however, does not stop here; we must constantly be on the lookout for transitional characters or characters in the very act of change. These transitional or evolutional characters appear at present to be of four kinds: first, *modifications,* or such as have been brought about during the life of the individual without necessarily being connected with germinal changes; second, *fluctuations,* or fluctuating variations, changes of degree or proportion which may be due either to somatic or to germinal causes, one of the most difficult problems in regard to fluctuations being to ascertain how much is germinal and how much is purely somatic; third, *saltations,* which are altogether germinal, or at least prenatal, in origin, including marked changes of kind, the 'sports' of Darwin and Galton, the 'discontinuous variations' of Bateson, and the 'mutations' of de Vries. Wide celebrity has been given to the word 'mutation' through the brilliant experiments and observations of de Vries, but the original significance of this term as employed by Waagen and Scott was a different one, and I think it probable that Waagen used it in the sense of determinate variation. Fourth, *rectigradation,* a new term with which I propose to characterize what in the year 1889 I described as 'definite variations'; it embraces changes which many writers have described as 'orthogenetic,' under the supposed law of direct change, usually in an adaptive direction, which is described as Orthogenesis; these probably are the 'mutations' of Waagen.

All the processes in column IV. are those which may be observed at the time or moment of observation in any organism, provided we have sufficient keenness of perception or sufficient knowledge to discriminate between them.

The elements of comparison given in column V., on the other hand, relate strictly to questions of origin, or to the past and the future, also to questions of comparison. The first broad distinction of comparison is between I., Homologous, and II., Analogous characters. In a strict interpretation homologous refers only to those elements which are 'homogeneous' (Lankester), or have an actual similarity of origin or ancestry. Under analogous characters there is a simple distinction to be drawn between the results of parallelism and of convergence, terms which I maintain should be used in a somewhat stricter sense than they have been hitherto. Looking to the past and future, we have III., the non-analogous characters and the broad phenomena of divergence. Appreciation of animal divergence, or of divergence in special structures and organs, naturally belongs to the evolutionary period of anatomical thought; a period beginning with the branching system of Lamarck and continued in the still clearer perception of divergence in the writings of Darwin. I have elsewhere proposed to employ the term 'adaptive radiation' for the general phenomenon of divergence as observed in a single group, distinguishing such a group in process of divergence as a 'radiation,' either a 'continental radiation' where diverging on a large scale, or a 'local radiation' where diverging in a more restricted environment.

It will be observed that while these ideas and terms are all evolutionary they are also *purely anatomical,* and restricted to anatomy. In a second communication the ideas and terms of modern evolution will be similarly treated.

HENRY F. OSBORN.

SOME PH.D. STATISTICS.

WE do not have to go very far back in the annals of higher education in the United States to discover a period when the percentage of instructors at a given university who had received the doctorate from the same institution, excluding foreign degrees, came perilously near the maximum. During the last ten or fifteen years, however, quite a change has been effected in this respect, so that at the present day there are few prominent universities in the country where the number of faculty members who hold a Ph.D. degree from another university is not larger than the number of those who received the degree from the institution in which they are giving instruction. There has been a noticeable change during the past decade also in the percentage of degrees received from foreign universities, and while there has been no perceptible decrease in the actual number of degrees taken abroad, there has been of course a considerable increase in the number conferred by American universities. In 1884 only 28 Ph.D. degrees were granted on examination by American universities; ten years later (in 1894) there were 233, and fifteen years later (in 1899) there were 325.

Chicago, Columbia, Cornell, Harvard, Johns Hopkins, Pennsylvania and Yale are the universities that are turning out the largest number of doctors, and it may be of interest to know how these universities, as well as a number of other representative institutions of higher learning, stand in the matter of 'inbreeding.' In the following figures only instructors of professorial rank, having a seat in one or another of the university faculties, are considered. In only three institutions is the number of degrees received from the home university larger than that received elsewhere, namely, in the case of Yale, where 46 of the 67 professors holding the Ph.D. degree, or 69 per cent., received it from Yale and 21 from other institutions; in the case of Johns Hopkins, where 27 out of 41, or 66 per cent., received it from Johns Hopkins and 14 from elsewhere; and in the case of Pennsylvania, where 26 out of 45, or 58 per cent., received it from Pennsylvania and 19 from elsewhere. The other institutions from which figures were secured run in the following order, the figures representing in each case the number and percentage of professors who received the degree from the home university: Cornell 32 out of 70, or 46 per cent.; Columbia 32 out of 73, or 44 per cent.; Michigan 10 out of 25, or 40 per cent.; Harvard 21 out of 55, or 38 per cent.; Princeton 12 out of 33, or 36 per cent.; Chicago 25 out of 86, or 29 per cent.; Wisconsin 13 out of 49, or 27 per cent.; California 4 out of 46, or 9 per cent. It is only natural that universities like California, Wisconsin and Chicago should have a high percentage of Ph.D.'s from elsewhere on their faculties.

The above figures also show that in the actual number of doctorates held by members of the faculties the universities rank in the following order: Chicago, Columbia, Cornell, Yale, Harvard, Wisconsin, California, Pennsylvania, Johns Hopkins, Princeton and Michigan. Chicago also has the largest number of Ph.D.'s from elsewhere, followed by California, Columbia, Cornell, Wisconsin and Harvard.

The following universities in the order named are represented by the largest number of doctors of philosophy at the institutions above enumerated, excluding in each case the degrees granted by the same university: Johns Hopkins, Harvard, Yale, Columbia, Princeton and Pennsylvania. Among foreign universities, Leipzig has by far the largest representation, having 37 doctors of philosophy on the faculties of the universities under discussion, as against 40 from Johns Hopkins. The other universities represented by more than one doctor follow in the order named: Göttingen, Halle, Berlin and Munich (10 each), Freiburg, Heidelberg, Strassburg, Jena and Rostock and Würzburg (2 each). Complete returns were not made by every institution, but the figures are close enough to reflect existing conditions with sufficient accuracy.

The statistics prove that most of the universities concerned attract to their faculties a considerable percentage of holders of Ph.D. degrees from other institutions, that Yale, Johns Hopkins and Pennsylvania are the chief exponents of 'inbreeding,' that the western universities, as might be supposed, draw the largest percentage of doctors from elsewhere, that Johns Hopkins has the largest Ph.D. representation of any American university, and Leipzig of any foreign university, on the faculties of the institutions under discussion.

RUDOLF TOMBO, JR.,
Registrar.

COLUMBIA UNIVERSITY.

BOTANICAL NOTES.

MICHIGAN FORESTRY.

THAT rational views as to forestry are steadily growing in popular favor is shown by the increasing attention which is given the subject by state and local organizations. The recent appearance of the report of the Michigan Forestry Commission forcibly emphasizes the changed attitude of the people with reference to the forests. Many years ago the writer was an interested eye witness of the lumbering operations which finally denuded the state of its fine forests, and at that time nothing that any one said had the least effect in staying the hands of the destroyers. There was but one thing to be done with the forests, and that was to destroy them. And now, alas, when it is too late to save even a remnant of the magnificent tree growth the public conscience has been awakened, and the enormity of the crime is beginning to be realized.

The report enumerates the steps taken by the commission in the campaign of education which it has inaugurated, and includes the report of the warden of the state forest reserves (Professor Roth), followed by a collection of essays by a considerable number of public-spirited citizens, all tending to create an interest in the planting or conservation of forests. The forest reserves include about 34,000 acres near Higgins and Houghton lakes in Crawford and Roscommon counties. Originally almost all of the land of these reserves was covered by heavy forest of pine, cedar, tamarack and some hardwoods. In a few striking sentences Professor Roth tells the story of the destruction of the great forest, and the transformation of the sylvan landscape into a dreary waste. It is a pitiful tale of greed for gain coupled with utter carelessness as to the future of the country. Photographs make very real the story he so graphically tells. Yet other photographs give us a view of the more cheerful story which may be told in the future when the seedlings now springing up are allowed to grow into a new forest. If the fires are kept out these areas may again be covered with trees. To this end the commission is working, and in this laudable undertaking every scientific man in the country will wish them Godspeed.

A NEW BOOK ON ECOLOGY.

AT last, after much delay, the University Publishing Company, of Lincoln, Nebr., has issued Professor Clement's book on 'Research Methods in Ecology.' An adequate review of this important contribution to modern botany will appear in due time, and it is only necessary to say now that it analyzes critically the problems which confront the practical ecologist (theoretical ecologists appear to have no such difficulties), and discusses the methods of solution with great detail, in which many illustrations and descriptions of instruments are used.

ORIGINAL DESCRIPTIONS OF SPECIES.

A. A. HELLER, of Los Gatos, California, has undertaken the publication of a series of fascicles in which appear the original descriptions of all of the North American species of certain genera of plants. He has already issued such fascicles for *Lupinus, Trifolium, Ribes, Castilleia* and *Artemisia,* including descriptions of 464 species. Each species is given a separate sheet, and the sheets for each genus are enclosed in special manila paper covers. The cheap price of these reprints (about one cent each) places them within the reach of all botanists who are interested in this department of systematic botany.

NORTH AMERICAN RUSTS.

PROFESSOR HOLWAY, of the University of Minnesota, has begun the publication of an important work on the rusts, entitled 'North American Uredineae,' of which Part 1 of Volume I. has just appeared. This part is a quarto pamphlet of 32 pages of text, accompanied with ten photomicrograph plates of uredospores and teleutospores. The arrangement is by hosts, the present part being devoted to the species of *Puccinia* parasitic on certain Ranunculaceae (*Caltha, Delphinium, Anemone, Pulsatilla, Clematis, Trautvetteria, Ranunculus, Cyrtoryncha*), Berberidaceae (*Berberis, Podophyllum*), Papaveraceae (*Capnoides*), Bromeliaceae (*Pitcairnia*), Commelinaceae (*Commelina*), Juncaceae (*Juncoides*), Liliaceae (*Chrosperma, Veratrum, Xerophyllum, Zygadenus, Allium, Brodiaea, Calochortus, Asparagus, Clintonia, Aletris, Smilax*), Amaryllidaceae (*Cooperia, Bomarea*), Iridaceae (*Iris*), Orchidaceae (*Cypripedium*, unknown orchid). The photographs are excellently reproduced, and with the full descriptions (all drawn from the specimens) should prove very helpful to the student of these plants.

Charles E. Bessey.

The University of Nebraska.

MUSEOGRAPHY.

An historical and bibliographical work of great value is that recently published by Dr. David Murray, of Glasgow, under the title of 'Museums, their History and their Use' (3 vols., Glasgow, 1904). The first volume forms a notable repository of information concerning the development of the museum as a scientific institution, beginning with the earliest times. Interspersed with accounts of the older museums and their exhibits are brief notices of scientific workers, together with their contributions and attitude of mind toward controverted questions. An excellent summary is given, for instance, of the discussion of fossils amongst learned circles of two and three hundred years ago and earlier.

The author remarks that his purpose has been to provide, in the first place, 'a short list of the books bearing on the bibliography of museums, which I had found useful, that is, a bibliography of bibliographies.' The next subject, museography, is dealt with more fully, but not exhaustively, after which is given a selection of books on the practical work of museums—the collection, preparation and preservation of specimens, their registration and exhibition. Nearly the whole of the second and third volumes is devoted to catalogues and other works relating to particular museums and special collections. Not the least important section of the work contains individual suggestions and criticisms on the part of the author, his extensive acquaintance with museums the world over rendering all that he has to say timely and instructive. Yet on the whole the work is written from the archeological standpoint, rather than the technical, or purely scientific.

C. R. E.

THE UNIVERSITY OF WISCONSIN.

The legislature of Wisconsin has passed a law giving the University of Wisconsin two sevenths of a mill tax for current expenses, and has made a special appropriation of $200,000 a year for three years for constructional and other emergency work. On the basis of the present assessed valuation the two sevenths of a mill tax will yield $525,000, which with the $200,000 make the appropriation from the state $725,000, even if there is no increase in the assessed valuation. The other sources of income are sufficient to make the budget of the university for the coming year about $1,000,000.

A number of appointments and promotions have been made: E. B. McGilvary, A.M. (Princeton), Ph.D. (California), Sage professor of moral philosophy of Cornell University, has been appointed professor of philosophy; and Edward C. Elliott, B.S. (Nebraska), Ph.D. (Columbia), now instructor in Teachers College, Columbia University, associate professor of education. Dr. Charles E. Mendenhall has been promoted to a professorship of physics; Dr. Frank C. Sharp to a professorship of ethics; C. F. Burgess to a professorship of engineering, and Ransom A. Moore, to a professorship of agronomy. Albert H. Taylor has been promoted to be assistant professor of physics; Leonard S. Smith, to be associate professor of topographic and geodetic engineering; Herbert F. Moore, to be assistant professor of mechanics, and Edwin G. Hastings to be assistant professor of agricultural bacteriology.

Instructors have been appointed as follows: *Mathematics*—R. S. Peotter, B.S. (Wisconsin), and R. A. Moritz, B.S., M.A. (Wisconsin). *Physics*—Leonard R. Ingersoll, B.S. (Colorado College), now fellow in physics. *Chemistry*—Roy D. Hall, B.S., M.S. (Wisconsin), Ph.D. (Pennsylvania); F. L. Shinn, B.S. (Indiana); Harry B. North, Ph.G., B.S. (Wisconsin), now assistant, and Edgar B. Hutchins, B.S. (Ottawa), M.S., Ph.D. (Wisconsin). *Education*—Walter F. Dearborn, A.B., A.M. (Wesleyan), Ph.D. (Columbia). *Mechanics*—M. O. Withey, C.E. (Thayer). *Mechanical drawing*—E. S. Moles, B.S (Wisconsin), and John E. Boynton, B.S. (Wisconsin). *Topographical engineering*—Ray Owen, B.S. (Wisconsin). *Hydraulic engineering*—Charles J. Davis, C.E. (Cornell). *Electrical engineering*—Frank J. Petura, B.S. (Wisconsin); George G. Post, B.S. (Wisconsin), now assistant, and John C. Potter, B.S. (Wisconsin), now assistant.

Assistants have been appointed as follows: *Anatomy*—David A. Crawford, B.A. (Wisconsin). *Botany*—William G. Marquette, B.A. (Wisconsin), now assistant; Ruth F. Allen, B.S. (Wisconsin). *Physics*—Willibald Weniger, B.A. (Wisconsin); R. A. Wetzler, B.S. (Minnesota); W. E. Wickenden, B.S. (Dennison); Elmer H. Williams, B.A. (Wisconsin); Archie S. Worthing (Wisconsin); Vernon A. Suydam, B.L. (Wisconsin); V. P. Spence, A.B. (Northwestern). *Zoology*—A. B. Clawson, B.S., M.S. (Michigan). *Civil Engineering*—R. F. Ewald, B.S. (Wisconsin).

THE MUSEUM OF THE BROOKLYN INSTITUTE.

ON June first the central section of the museum of the Brooklyn Institute was opened to the public, as well as the halls that have been temporarily closed, owing to the installation of new collections and the rearranging of the picture galleries. The ethnological collections obtained by Mr. Culin during two seasons' work in Arizona and New Mexico are shown for the first time. They occupy the hall formerly devoted to casts from the antique, and comprise a well-balanced series illustrating the arts and industries of the Pueblo Indians, while special attention has been given to objects pertaining to their religious ceremonies. There are thus displayed about 200 small figures representing the costumes worn by the dancers and 100 of the actual masks worn on these occasions, this being much the most complete collection in any museum.

The natural history collections have been completely rearranged during the past year and extensive additions made to them, but, owing to the architectural features of the central section a thoroughly systematic arrangement will not be possible until the completion of the new wing now in process of construction. Among the special collections still in process of installation may be mentioned one illustrating the problem of flight and the various adaptations by which it has been solved in nature, and one illustrating individual, sexual, seasonal and geographic variation. The latter includes eight of the thirteen sub-species of horned owls recognized by Mr. Oberholser, the contrast between the Alaskan, Hudsonian and desert forms being very striking. A group of Ellesmere Land musk oxen, *Ovibos moschatus wardi*, has also been placed on exhibition, which includes an old male, a female and yearling from the same herd.

AWARD OF THE BARNARD MEDAL.

THE Barnard medal of Columbia University has been awarded to M. Henri Becquerel. In making this award at the recent Columbia exercises, President Butler said: "In accordance with the terms of the will of Frederick A. P. Barnard, tenth president of Columbia University, a gold medal is established, known as the Barnard medal for meritorious service to science. This medal is awarded at commencement at the close of every quinquennial period, to such person, if any, whether a citizen of the United States or of any other country, as shall, within the five years next preceding, have made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as, in the judgment of the National Academy of Sciences, of the

United States, shall be deemed most worthy of such honor. The Barnard medal was first awarded at the commencement of 1895, to Lord Rayleigh, and to Professor (now Sir) William Ramsay. At the commencement of 1900 the Barnard medal was awarded to Professor Wilhelm Conrad von Röntgen. On the nomination of the National Academy of Sciences, the award for 1905 is made to Henri Becquerel, member of the Institute of France, for important discoveries in the field of radioactivity, and for his original discovery of the so-called dark rays from uranium, which discovery has been the basis of subsequent research into the laws of radio-activity, and of our present knowledge of the same."

THE AMERICAN ANTHROPOLOGICAL ASSOCIATION.

The American Anthropological Association will meet in San Francisco, California, August 29–31. It is planned to combine the meeting with an excursion by the association to the Lewis and Clark Centennial Exposition at Portland. Arrangements will be made facilitating the visit by members of the association to educational and other points of interest on the Pacific Coast. This will be the first meeting of the association, or of any body of national scope devoted to anthropology, held on the Pacific Coast, and a large attendance from the western states is expected. Professor F. W. Putnam will preside.

Titles of papers and applications for membership should be sent to Dr. A. L. Kroeber, secretary of the committee on arrangements, Affiliated Colleges, San Francisco, or to Dr. George G. MacCurdy, secretary of the association, Yale University, New Haven, Conn. The headquarters of the association will be the Museum of the Department of Anthropology of the University of California, Affiliated Colleges, San Francisco. Further information in regard to special railway rates and other arrangements connected with the meeting may be obtained from Dr. MacCurdy.

SCIENTIFIC NOTES AND NEWS.

Princeton University has conferred the degree of Doctor of Laws on Professor Charles Augustus Young, who has this year become professor emeritus of astronomy, after holding the chair at Princeton since 1877.

Columbia University has conferred the degree of Doctor of Science on Dr. R. S. Woodward, who has resigned the chair of mechanics and mathematical physics to accept the presidency of the Carnegie Institution.

Oxford University will on June 28 confer its Doctorate of Science on George H. Darwin, F.R.S., professor of astronomy at Cambridge.

The University of Manchester has conferred the honorary degree of LL.D. on Dr. Nicholas Murray Butler, president of Columbia University.

Syracuse University has awarded the degree of LL.D. to Professor David Eugene Smith, who holds the chair of mathematics at Teachers College, Columbia University.

The University of Colorado has conferred the degree of Doctor of Laws upon Dr. Richard W. Corwin, chief surgeon of the Colorado Fuel and Iron Co.

Columbia University has conferred the degree of M.S. on George Francis Sever, professor of electrical engineering in the university, and on Frederick A Goetze, superintendent of buildings and grounds.

Mr. W. T. Brigham, director of the British Museum of Ethnology at Honolulu, has been given the degree of Doctor of Science by Columbia University. He was presented by Dr. H. C. Bumpus, director of the American Museum of Natural History.

Professor H. A. Lorentz, of Leiden, has been elected a corresponding member of the Berlin Academy of Sciences.

At the commencement exercises of the University of Pennsylvania a portrait of Dr. William Osler was presented by Professor Howard M. Fussell, on behalf of the classes from '85 to '91, who studied under Dr. Osler when he occupied the chair of clinical medicine at the university.

The Glasgow University Club of London held its annual dinner on May 26, when Sir William Ramsay presided. Lord Kelvin was elected president of the club for the ensuing year.

At the annual meeting of the Iron and Steel Institute held in London, May 11, a Carnegie research scholarship of $500 was awarded to Henry Cook Boynton, instructor in metallurgy and metallography in Harvard University.

Mr. C. D. Howard, associate chemist of the West Virginia Agricultural Station, has been appointed chemist to the New Hampshire Board of Health, Concord, N. H.

Dr. August Hoch, at present assistant physician and pathologist at McLean Hospital, Waverly, Mass., will assume the position of first assistant physician at Bloomingdale Asylum, White Plains, N. Y., where he will continue his researches in psycho-pathology.

Dr. W. B. Scott, professor of geology and paleontology at Princeton University, gave the oration at a joint meeting of Phi Beta Kappa and Sigma Xi societies at the University of Pennsylvania, on June 14.

Dr. A. S. Wheeler, associate professor of organic chemistry in the University of North Carolina, will give a course of lectures on organic chemistry at the Harvard University summer school.

In commemoration of Audubon's one hundred and twenty-fifth birthday, the American Museum of Natural History has placed on exhibition a collection of Audubon relics. Among the objects is the portfolio in which Audubon carried specimen plates while securing subscribers to his great work in this country and abroad, together with sketches and finished plates.

A second International Congress devoted to the Rontgen rays will be held in Amsterdam in 1908.

The British Medical Journal states that the Laryngological Society of Vienna is about to take steps to organize a festal celebration to be held in 1908 in honor of the jubilee of medical, as distinguished from physiological laryngoscopy. It was in 1858 that Professor Turck showed the far-reaching applications in the domain of medical practice of Manuel Garcia's great discovery. It is hoped that all the leading representatives of laryngology throughout the world will be present on the occasion.

The Scottish Geographical Magazine states that an expedition has recently started with the object of thoroughly investigating the oceanography and biology of the region between India and Madagascar. The vessel employed is H.M.S. *Skylark,* under the command of Captain Boyd Somerville, who is accompanied by two civilian men of science, Mr. Stanley Gardiner and Mr. Forster Cooper, both of whom have already been engaged in scientific work in the area under investigation. The *Skylark* is to go first to the Chagos Archipelago, then to Mauritius, which it is expected will be reached about August 1. The voyage will then be continued *via* the Cargados reef to the Seychelles, whence the return will be made to Colombo, the starting-point. Messrs. Gardiner and Cooper are to be left at the Seychelles, where they hope to spend some months in scientific work, returning home in January, 1906.

It is stated in *Nature* that at the forty-second general meeting of the Institution of Mining Engineers, held in London on June 2 and 3, several interesting papers were read. Mr. T. Y. Greener dealt with the firing of boilers by waste heat from coke ovens. Mr. M. R. Kirby described the compound winding engine at Lumpsey iron mine. Its steam consumption is only 38 pounds to 40 pounds per indicated horse-power hour. Mr. F. Hird gave the results of tests of the electric winding engine at Friedrichshall, and Mr. E. Lozé described electric winding engines installed at French collieries. Mining education in the United States was discussed by Professor H. Eckfeldt, and in New Zealand by Professor J. Park. Coal mining in India was dealt with by Mr. T. Adamson. Mr. J. Jeffries described the occurrence of underground fires at the Greta colliery, New South Wales. Mr. W. C. Blackett and Mr. R. G. Ware described a striking innovation in mining practise, the use of electrically driven mechanical conveyors for filling at the coal-face. Two years' experience has shown a saving of 48 per cent. over the ordinary pick and shovel method.

Lastly, Mr. A. R. Sawyer gave an account of the geology of Chunies Poort, Zoutpansberg, Transvaal. Incidentally, he mentioned some old copper workings where native copper occurs in some abundance in dolomite.

The Naturwissenschaftliche Verein at Karlsruhe has, thanks to a considerable legacy, been placed in a position to establish two new stations for seismic observations, the one in an underground passage at Turmberg, near Durlach, the other in Freiburg.

The London *Times* states that a large company assembled in the Oxford University Museum on May 31 at the annual *conversazione* of the Junior Scientific Club. An attractive program had been arranged. Professor E. B. Poulton, F.R.S., delivered a lecture on 'Some Recent Work on Protective Resemblance and Mimicry in Insects,' and Dr. A. E. Tutton displayed some of his latest lantern slides of Alpine scenery. There were demonstrations of the properties of radium and spinning tops, experiments on color, and an exhibition of thermit and high temperatures, which included the making of artificial diamonds. Messrs. Zeiss exhibited their instrument for seeing ultra-microscopic particles, and there was a working installation of wireless telegraphy. The Pitt-Rivers Museum was thrown open, and music was provided by the band of the Grenadier Guards.

Nature says that under the name of the 'Potentia Organization,' an international association has been formed with the object of establishing among nations a mutual relationship and cooperation for the diffusion of accurate information and unbiased opinion concerning international events and movements, and to combat narrow, prejudiced, and often interested views and news that contribute so much to international mistrust and misunderstanding. It is proposed to publish throughout the world, through the medium of newspapers and reviews, statements of simple fact and expressions of opinion by eminent public men of all nations on all important political, social, philosophical, economic, scientific and artistic questions, to present the sincere views of experts on all current international events, and to refute false or biased news and views calculated to spread error and to endanger the peace and progress of the world.

UNIVERSITY AND EDUCATIONAL NEWS.

At the commencement of Princeton University it was announced that an annual income of $100,000 had been guaranteed for the preceptorial system, that $300,000 had been given for a recitation hall and that 336 acres of land had been added to the property of the university.

Mr. Morris L. Clothier, of Philadelphia, has given $50,000 to Swarthmore College, to endow a professorship of physics.

The library building of Vassar College, erected by Mrs. F. F. Thompson, of New York, at a cost of $500,000 was dedicated last week.

Dr. A. W. Harris, director of the Jacob Tome Institute, and previously director of the Office of Experiment Stations of the Department of Agriculture, has been elected president of Northwestern University.

Mr. Henry S. Drinker, general solicitor of the Lehigh Valley Railroad, has been elected president of Lehigh University, to succeed the late Dr. Thomas Messinger Drown.

Dr. Charles Henry Smyth, professor of geology at Hamilton College, has been elected professor of geology at Princeton University.

Dr. Nicholas Senn has been elected professor of surgery and Dr. Frank Billings professor of medicine at the University of Chicago.

Dr. H. K. Wolfe, formerly professor of philosophy at the University of Nebraska and recently principal of the Lincoln High School, has been elected professor of philosophy and education at the University of Montana.

Mr. W. L. Hall, of the U. S. Bureau of Forestry, has been appointed lecturer on tree planting at Yale University.

Ivan E. Wallin, B.S. (University of Iowa, '05), has been elected professor of natural history in Upsala College, New Orange, N. J. He has been specializing in the biological sciences at Augustana, Princeton and Iowa during the last three years.

SCIENCE

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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 30, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND HARVARD UNIVERSITY.

THE proposed affiliation or alliance of the Massachusetts Institute of Technology with Harvard University was, as we have already reported, approved at a meeting of the corporation of the institute on June 9. Thirty-two of the forty-seven members of the corporation were present, and by a vote of 20 to 12 it was agreed to accept the terms of the agreement drawn up by the committee of the two institutions. Before the agreement can become effective the corporation and overseers of Harvard University must take action and several legal questions must be passed upon by the courts. It will be remembered that on May 5 the faculty of the institute adopted by a vote of 56 to 7 the report of the committee adverse to the affiliation. A full account of the report adopted by the faculty and of the minority report, together with an account of the meeting of the alumni on May 4 has been published in a special issue of *The Technology Review*.

In view of the great importance of the proposed merger for university development and technological education we reproduce here: (1) The agreement prepared by President H. S. Pritchett and Professor A. Lawrence Lowell on behalf of the institute and Dr. H. P. Walcott and Charles Francis Adams, 2d, Esq., on behalf of the university, now adopted by the corporation of the institute; (2) the will of the late Gordon McKay in so far as it relates to his bequest to Harvard University, and (3) extracts from the report adverse to the alliance adopted by the faculty of the institute and extracts from the minority report.

AGREEMENT BETWEEN HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Harvard University and the Massachusetts Institute of Technology, being convinced, after a careful consideration of the conditions which affect the work of education in industrial science, that such work can be greatly advanced and enlarged by a cooperation of the two institutions, in order to secure mutual assistance, render possible a larger enterprise, promote economy, avoid duplication and competition, and give to the purpose of donors who have bestowed money in trust for that object a fuller accomplishment, do make this agreement, which shall endure so long as it shall be found to serve, to the satisfaction of both institutions, the objects above declared. But, whereas the carrying out of such agreement will require the employment of the income of the funds which the University holds, or will hereafter hold in trust, and the University feels that faithfulness in the performance of these trusts which it has accepted is its first duty, to which all other considerations must yield, this agreement shall not go into effect until and unless the University shall have applied to the Supreme Judicial Court for instructions and the court shall have made a decree that this agreement may be carried out without violation of its duties as a trustee and in accordance with law and equity.

I.

The organization of the University, the organization of the Institute, and the title of each to its property and funds shall remain unaffected by this agreement, as shall also the rights and duties of each in investing and managing its funds.

II.

The institution for the combined work of promoting and furnishing education in industrial science, which it is the object of this agreement to establish, shall retain the name of the Massachusetts Institute of Technology; it shall be under the direction of an Executive Committee, and the instruction therein shall be given by a Faculty, which two bodies shall be constituted as herein below provided.

III.

The said Executive Committee shall consist of nine persons, to be designated by the Massachusetts Institute of Technology, of whom two shall be the President of the Corporation of the Institute and the Treasurer of the Institute, and three shall be members of the Corporation of the University.

Subject to the restrictions herein below expressed, the said Executive Committee shall have the general administration and superintendence of all matters concerning said combined work, including the appointment of officers of instruction and government, and of servants, the power to remove any of them, the fixing of their salaries and the prescribing of their duties, the care of buildings, property, and equipment, the appropriation of money put at its disposal under this agreement, the fixing, collecting, and expending of students' fees, and the supervision and direction of the work of the Faculty, these being substantially the powers now conferred on the Executive Committee of the Institute by its by-laws; it being, however, expressly provided that all appropriations from money furnished either by the University or by the Institute, and all proposed appointments or removals of officers whose salaries are to be paid therefrom, shall be submitted to the Corporation concerned and approved by it before being finally adopted, it being understood that students' fees shall be deemed to be furnished by the Institute, and that no change shall be made in those fees without its approval.

The said Executive Committee shall keep records of its proceedings, and shall make reports to the Corporation of the University and the Corporation of the Institute annually, and at such other times as either Corporation may request.

IV.

The President of the Institute for the time being shall be the President of the said Executive Committee, and shall preside at its meetings, when present. His salary, as fixed by the Corporation of the Institute, shall be paid from the funds furnished by the Institute. He shall be the Chairman of the Faculty, shall have the superintendence of the several departments, and shall act as general executive and administrative officer, subject to the direction and control of said Executive Committee. He shall annually make a report to the Corporation of the University and to the Corporation of the Institute. Whenever a person shall vacate the office of President of the Institute, he shall thereupon cease to be a member of the said Executive Committee.

V.

The Treasurer of the Massachusetts Institute of Technology shall be *ex officio* the Treasurer of the said Executive Committee. He shall, as Treasurer of the said Executive Committee, have charge of the funds put at the disposal of said committee, shall make such payments as the committee may authorize, shall keep accurate accounts of all money received and expended, and shall make report of his doings annually, or oftener if required, to the said committee, and to the Corporation of the University and to the Corporation of the Institute.

VI.

The Faculty shall consist of all the present professors, associate professors, and assistant professors of the Institute, and all professors, associate professors, and assistant professors of the University who now give courses of instruction leading to degrees in industrial science, and such officers hereafter appointed as said Executive Committee may designate. The present professors, associate professors, and assistant professors of the University as aforesaid shall not be removed nor have their present salaries reduced without the consent of the Corporation of the University.

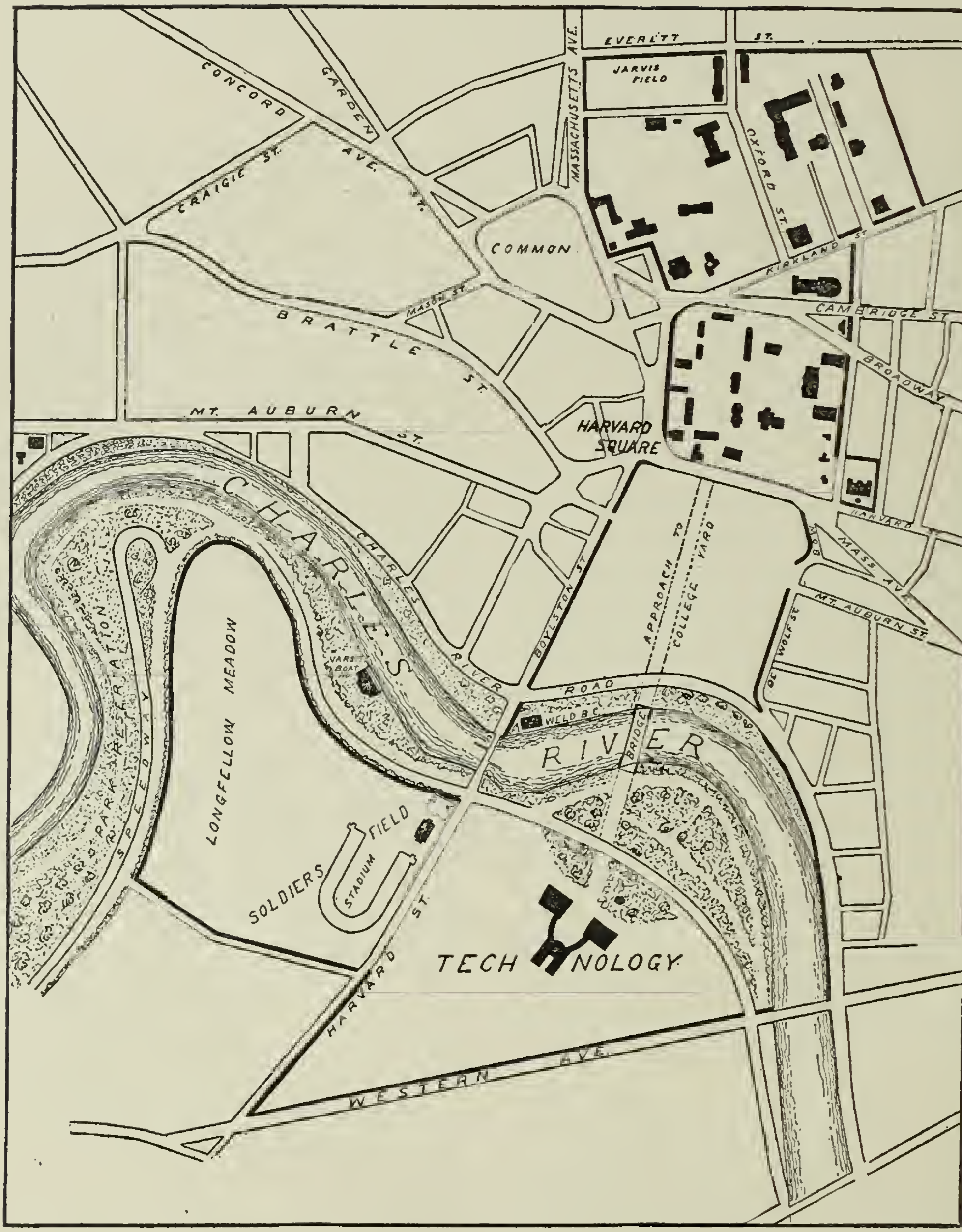
Subject to the supervision and direction of the said Executive Committee the Faculty shall have charge of instruction and discipline.

VII.

Subject to the reservations hereinafter set forth the University shall place at the disposal of said Executive Committee, as above provided, the net income of all funds which are now credited on its books to the credit of the Lawrence Scientific School, also the use of all machinery, instruments, and equipment which the University holds, and the income of all property which it may hereafter acquire for the promotion of instruction in industrial science, and also three fifths, but no more, of the net income which may accrue from the bequest and devise of the late Gordon McKay.

VIII.

Subject to the reservations herein set forth, the Institute shall place at the disposal of the said Executive Committee the net income of all funds and the use of all property and equipment which the Institute may hold for the promotion of instruction in industrial science, reserving only



Map showing the proposed site of the Massachusetts Institute of Technology and its relation to Harvard University. (From the Boston *Transcript*.)

such amounts and property as it may require to maintain its organization and to carry on such functions as may remain to it independently of the promotion of industrial science.

IX.

In so far as money contributed by either Corporation under this agreement may be used by the said Executive Committee for the purchase of equipment or supplies, the title thereto shall be in the Corporation whose money is appropriated therefor.

X.

The site of the institution shall be in Boston on the right bank of the Charles River, as nearly as practicable opposite to Harvard Square, and the Massachusetts Institute of Technology shall there erect, furnish, and equip buildings having the capacity of at least its present buildings. But the Institute shall not be required to proceed with such purchase and construction until it shall have sold a sufficient part of the land which it now owns. Provided, however, that this agreement shall be avoided if at the end of four years from the time when this agreement goes into effect the Institute shall not have purchased said land and proceeded to a substantial extent with such construction.

XI.

Within three years after the Massachusetts Institute of Technology begins the construction of such new buildings, if the Institute is then prepared to give in its new location to the students of the Lawrence Scientific School all needed instruction in industrial science, the Lawrence Scientific School shall be discontinued as a separate school of industrial science so long as this agreement remains in force.

XII.

The degrees of Bachelor, Master and Doctor in Science, so far as given in industrial science, and all degrees in engineering, together with the requirements of courses of study leading to these degrees, shall be within the province of the Faculty; and these degrees shall be conferred by the Corporations of the University and the Institute, acting separately.

XIII.

Male students in the Institute shall have the same privileges as students in Harvard University in the use of the playgrounds, museums, and libraries of the University.

Under regulations to be made by the two Corporations, and on payment of proper fees, students of the Institute shall be admitted to courses of instruction and the use of laboratories of the University, outside of those pertaining to industrial science, and students of the University to the courses and use of laboratories of the Institute.

XIV.

The Corporation and Overseers of the University and the Corporation of the Massachusetts Institute of Technology shall each have full right at all times to inspect the institution, and suggest to the said Executive Committee changes in the methods of management.

XV.

The Department of Architecture in the University and in the Institute respectively are not included in this agreement, but remain unaffected hereby.

XVI.

It is expressly provided that, as regards the funds and property of the University and of the Institute respectively, this agreement shall be subject to any special terms and requirements upon which such funds and property may be held; and any property or funds which may be held at any time by either Corporation under such terms and restrictions as would prevent the use of them in the precise manner contemplated by this agreement shall, nevertheless, be used by the two Corporations respectively for the support, benefit, or encouragement of the scheme agreed upon, in such manner as may be permissible and in accordance with the trusts upon which they may be held.

XVII.

The arrangements established by this agreement may be terminated at any time either by the President and Fellows of Harvard University or by the Corporation of the Massachusetts Institute of Technology, upon reasonable notice to the other Corporation.

In the event of the termination of this agreement, the Massachusetts Institute of Technology must pay, at such prices and upon such terms as the parties may agree upon, and, if they can not agree thereon, as may be fixed by arbitration (usual arbitration clause), for any buildings or fixtures upon said site, paid for with funds furnished by the University.

XVIII.

This agreement shall take effect when finally adopted and approved by the Corporation and the Overseers of the University and the Corporation of the Institute, and when and if a decree of the Supreme Judicial Court, as provided for in the preamble hereof, shall have been obtained.

EXTRACT FROM THE WILL AND CODICILS OF THE LATE GORDON MCKAY.

I direct that eighty per cent. of the balance of said net annual income, after paying the annuities (the remaining twenty per cent. being held as a reserved fund to cover any future possible deficiency in the annual income to pay said annuities), shall be safely invested by my trustees from time to time until such accumulations amount to the sum of one million dollars, and then I direct my trustees to pay over said sum of one million dollars to 'the President and Fellows of Harvard College in their corporate capacity,' if said Corporation shall accept the same for the purposes and upon the terms and conditions hereinafter set forth, to be held and applied by them and their successors in said capacity for the purposes and trusts hereinafter declared.

I also direct said trustees to pay to the said President and Fellows (if and after said sum of one million dollars has been paid over to them, as aforesaid) annually eighty per cent. of the balance of the net income accruing from the remainder of my estate after paying the existing annuities; and upon and after the death of the last surviving annuitant I direct said Trustees to pay over to the said President and Fellows of Harvard College all the residue of my estate, including all unexpended income, all of which said sums I give to the said President and Fellows of Harvard College, provided they accept the same, as aforesaid, strictly upon the trusts and purposes following, namely:—

I direct, if the said Corporation, the President, and Fellows of Harvard College accept said gift, that the sum total of all the property and moneys conveyed by my trustees to the President and Fellows of Harvard College shall be forever known and described in the records of the President and Fellows and on the books of their Treasurer as the Gordon McKay Endowment.

I give the President and Fellows full powers to hold, manage, and protect, improve, sell, invest, and reinvest at their discretion, from time to time, the property in which this Endowment may at any time be invested. I also give the said Corporation authority, in case the principal shall be at any time impaired through misfortune, to accumulate the income of the Endowment, or any part thereof, until the principal shall be made good; but, in order that the principal and income may share in the guaranty or insurance which is derived from the large mass and wide distribution of the University's investments, I prefer that the investments of the Endowment be merged, as soon and as far as in the discretion of the President and Fellows they prudently and equitably may be, with the general investments of the other permanent funds held by the President and Fellows.

The net income of said Endowment shall be used to promote applied science:—

First. By maintaining professorships, workshops, laboratories, and collections for any or all of those scientific subjects which have, or may hereafter have, applications useful to man; and

Second. By aiding meritorious and needy students in pursuing those subjects.

Inasmuch as a large part of my life has been devoted to the study and invention of machinery, I instruct the President and Fellows to take special care that the great subject of mechanical engineering in all its branches, and in the most comprehensive sense, be thoroughly provided for by my Endowment.

I direct that the President and Fellows be free to provide from the Endowment all grades of instruction in applied science, from the lowest to the highest, and that the instruction provided be kept accessible to pupils who have had no other opportunities of previous education than those which the free public schools afford.

I direct that the salaries attached to the professorships maintained from the Endowment be kept liberal, generation after generation, according to the standards of each successive generation, to the end that these professorships may always be attractive to able men, and that their effect may be to raise, in some judicious measure, the general scale of compensation for the teachers of the University.

I direct that the professors supported from this Endowment be provided with suitable assistance in their several departments by the appointment of instructors of lower grades and of draughtsmen, foremen, mechanics, clerks, or assistants, as occasion may require, my desire being that the professors be free to devote themselves to whatever part of the teaching requires the greatest skill and largest experience and to the advancement of their several subjects.

I direct that the President and Fellows be free to erect buildings for the purpose of this Endowment, and to purchase sites for the same, but only from the income of the Endowment.

I direct that all the equipment required to illustrate teaching or to give students opportunity to practise, whether instruments, diagrams, tools, machines, or apparatus, be always kept of the best design and quality, so that no antiquated, superseded, or unserviceable implement or machinery shall ever be retained in the lecture-rooms, workshops, or laboratories maintained from the Endowment.

Finally, I request that the name Gordon McKay be permanently attached to the professorships, buildings, and scholarships, or other aids for needy students which may be established, erected, or maintained from the income of this Endowment.

EXTRACTS FROM THE MINORITY REPORT IN FAVOR OF THE ALLIANCE.*

I. If the plan is not adopted, Harvard will be obliged to energetically develop the Lawrence Scientific School as a broad college of applied science. With her resources, reputation, and large body of alumni, and profiting by the lessons of experience, there is no doubt that she can make this school a success. This is abundantly proved by the experience of other universities which have technical schools. This school will be a rival of the Institute in the same community.

II. Competition in business or in education always involves some economic waste. In education it is beneficial only if necessary to keep up the spur to endeavor. The Institute does not require competition with

* This report was signed by Professors Fay, Jaggar, McKibben, Moore, Swain, Walker, and was supported by President Pritchett.

Harvard for this purpose, and without it will have ample competition with the rapidly growing schools of the Middle and Western States.

III. Of two competing schools, either one will be better than the other or they will be different. If Harvard should build up a great technical school, though ours might on the whole be the better, Harvard would undoubtedly draw to herself many strong students. Every strong student that we lose is a distinct disadvantage to us. We should keep all the strong students, if possible, and let the weak ones go to other schools.

If Harvard should make the Lawrence Scientific School a graduate school, as we understand is desired by its Dean, would not many of the strongest men who come to Boston to study engineering prefer to go where they would be associated solely with more mature men, all having completed their undergraduate courses and devoting themselves entirely to professional work, instead of coming to the Institute, where they would be associated with younger men, and with many special students, in an undergraduate school?

IV. Technical education in this country is scarcely fifty years old. It is not yet on the same plane with instruction in the so-called learned professions. The time has not yet come for making engineering schools generally graduate schools, like so many of those of law and medicine. The Institute and most other engineering schools must remain primarily, for some time at least, undergraduate schools; but the level of industrial education will in the course of time be gradually lifted. The engineer, in order to reach the highest standard, will be expected to be liberally trained and yet to be a specialist. The Institute being one of many, when the university technical schools more generally reach the standard of the Institute,—and some of them have already fully reached and perhaps in some respects exceeded it, —is there not ground for believing that the young man who desires to qualify himself most completely for the engineering profession will seek the school which has the broadest environment, where he will be brought into relations with students of other professions?

V. The Institute having shown the way, there are now many technical schools where forty years ago there were few. A great majority of these are intimately connected with universities, and the fees at many of them are very low; they are doing excellent work, some as good work as the Institute; they have a much larger body of students; and they are turning out each year a much larger body of graduates than the isolated technical schools. The influence of these university technical schools, industrially and educationally, is increasing relatively in comparison with the isolated technical schools. May not our own influence diminish in the course of time, as the body of alumni of the university technical schools increases in number and in influence? Will we not gain by placing ourselves in the main educational current in the country, by allying ourselves with our most powerful university, especially as we can do so without sacrificing our methods or our control?

VI. Competition from the West will increase. The industrial centre of the country is shifting. When the Institute was established, it was in New England; and even the iron industry and the mining industry were important here. As the years go by, new technical schools will be established in the West, at places like Chicago and Pittsburg, either independent or connected with universities. These schools may well be in closer touch with the industries of the country than any school in New England would be. When they shall have had time to grow to their full development, what will be the effect upon the Institute of Technology, especially if it is isolated, out of the main current of educational development, and actively competing for support and students with another strong school not three miles distant?

VII. If this agreement is rejected by the Institute Corporation and Harvard energetically develops her technical school, Harvard alumni all over the country—lawyers, bankers, merchants, engineers, men in responsible positions in the great industries—will be enlisted in an active campaign to promote Harvard interests as against Institute interests. By acting together and giving the preference to Harvard graduates, they may at least seriously hamper the growth and retard the development of the Institute. By allying ourselves with Harvard, we should gain the active support of this large and influential body of men instead of their opposition.

VIII. By combination and cooperation instead of competition there is economy in administration; in heads of departments; in libraries and photographs; in museums and collections; in lecture apparatus and similar appliances; in buildings, especially as regards large lecture-rooms not often used; and, to a greater or less extent, in laboratory apparatus.

IX. There is also an economy or an increase of efficiency in combination, with reference to the instructing force. With the same number of men that would be required for two separate institutions a single institution would allow greater specialization in the teaching, permitting the student to come in contact with a larger number of inspiring teachers, or it would enable more than one teacher to teach the same subject, thus stimulating each to do his best. This stimulus would be greater if the two teachers were in one institution than if they were in two. There might, and probably would, also be an economy in the number of teachers, especially in the purely lecture courses, and, as already stated, in heads of departments.

X. If Harvard energetically develops her technical school, she will probably, in course of time, have more resources available than the Institute, considering her large number of wealthy alumni and their relations to the business world. The McKay will provides "that the salaries attached to the professorships maintained from the endowment be kept liberal, generation after generation, according to the standard of each successive generation, to the end that these professorships may always be attractive to able men, and that their effect may be to raise in some judicious measure the general scale of compensation for teachers of the university." In the course of time, therefore, when the McKay money becomes entirely available, it seems inevitable that Harvard will have a very high standard of salaries for professors in her technical school,—probably much higher than those at the Institute. In this case she could attract to these positions the ablest men, who can not now afford to be teachers because of the inadequate reward. Whether under these conditions the Institute would be the leader in technical education in this community is at least doubtful.

XI. Increase in the number of students, if accompanied by corresponding adaptation or organization of the teaching force, should also conduce to economy and efficiency.

XII. Whether the plan is adopted or not, we can limit our numbers by raising the standard. If increase of numbers is a disadvantage, we should limit them in this way rather than in any arbitrary way. By adopting the proposed plan, we retain the field, and can get all the strongest students from this community. If there are two schools, Harvard will very likely get as many as we do.

XIII. The addition of the Harvard Faculty to that of the Institute would be a distinct gain. Whether all would harmoniously work together at once is of little consequence. Temporary adjustments might have to be made. With broad-minded cooperation a larger efficiency would result by adding to our body a staff of able teachers with new ideas and without Institute traditions, but animated by ideals and purposes as high as our own. Of all men the teacher is most likely to get into a rut. In-breeding emphasizes this tendency. The influx of a body of new men with other points of view than our own would tend to counteract it.

XIV. If the proposed plan should result in more intimate association between our Faculty and the Faculty of Harvard College, the result would be beneficial.

XV. Institute students are given a narrow training, and would benefit by association with men studying the humanities and the other professions.

XVI. One great lack which Institute men have always felt is college life and college spirit. Many of them come from their homes or boarding places in the morning, attend their classes, and go home at night, seeing little of their fellows, and gaining no experience in the art of getting on with men. Their after-success will probably depend as much upon their ability to deal with men as upon a knowledge of their profession, and their progress may be much retarded by a lack of some qualities which they might gain at the Institute if they could take the time for more intimate association with their classmates. Moving to a site out of town would give the opportunity for a change in this respect, since it would render possible the introduction of dormitory life.

XVII. The surroundings of many of our Institute students in cheap boarding houses, with poor food and the temptations of a great city about them, are in many cases most unfavorable. We believe the distractions and diversions of such a life, and even the distractions in home life from the presence of friends and relatives and from home chores and duties, are much greater on the average than those which would arise under proper management in the dormitory system. The proposed plan would be an improvement over present conditions, because a larger proportion of students would live in the suburbs, and because dormitories might be established, which is now impracticable.

XVIII. Educational institutions must depend more and more upon gifts from wealthy men. Harvard University and the Institute are in the same community. They must appeal for support to the same class of persons, and in many cases to the same individuals. If the two were working together, the finanical results would be better than if the two were working separately and in opposition to each other.

XIX. Rich men who have large sums of money to give away desire to have their gifts expended economically, and, as a rule, they believe that economy results from combination and cooperation rather than from competition. If this agreement should be declined by the Institute, many of them would say that the Institute was unwilling to cooperate, and thereby increase efficiency and economy, while Harvard University was willing to cooperate. This attitude would render them less likely to give to the Institute.

The present plan seems to offer almost

the ideal form of affiliation. The Institute students, together with those now registered in the Lawrence Scientific School, number about 2,100; the Harvard College undergraduates number about 2,000. The technical school, therefore, would be the largest part of the combination, and would be subject to its own Faculty. It would seem most improbable that under these circumstances the smaller body, the great majority of whom are also earnest men, could unfavorably affect the larger and more compact professional body.

XXI. The reciprocal privileges which the plan proposes would very likely be of great value to both institutions, particularly in the case of advanced students.

XXII. By the plan proposed we can get all the benefits of combination and cooperation without relinquishing the power to do anything we are able to do under present conditions.

XXIII. The plan proposed would be of advantage to Harvard for many of the reasons which have already been adduced.

XXIV. The plan proposed would be of benefit to the community by giving it on the whole better advantages for technical education than could be obtained in any other way, and by enabling it to enthusiastically support, financially and morally, a single great institution with which the name of Boston and Massachusetts would be everywhere associated.

Conclusion.

Weighing the arguments in favor of the plan and those against it, we believe that those in favor decidedly outweigh those against, and that the possibilities are offered us of building up a better and a greater Institute of Technology than has hitherto existed. We believe, moreover, that the plan would be an educational benefit not only to the Institute, but to Harvard University and to the community. Boston would have one great technical school uniting the forces of two great institutions, and with a united community supporting it. It may be anticipated that it would not be allowed to suffer financially. The Institute would be free, under the plan, to develop in any way which might seem best, and it could do anything under the plan it can do at present, with the added advantage of Harvard's support. We could draw to us the strongest students not only from this community, but from other parts of the country, without suffering any of the disadvantages which would arise, as we believe, from the active competition of a neighboring and powerful school. The best way, and indeed the only way to accomplish in full measure the greatest future for the Institute, would seem to us to lie in securing control of the field of technical education in this community.

EXTRACTS FROM THE REPORT ADVERSE TO THE ALLIANCE ADOPTED BY THE FACULTY.

In the list of advantages to the Institute connected with the proposed agreement, removal to the Brighton location has been included by few. President Pritchett does not view it with complete favor, and opinions differ merely as to the degree of disadvantage. Apart from the financial question and the mandatory character of the agreement in this respect, the proposed site has disadvantages connected with the housing and life of the students and the problem of transportation.

At present 44 per cent. of our students live at their own homes, with advantage to themselves and to the Institute. Undoubtedly this has an important conservative effect in determining the atmosphere of the Institute. Removal to a more distant site would greatly decrease this number, and increase the total cost of living to the student body. It would also introduce the problem of establishing a dormitory system—a problem altogether too important to be settled thus incidentally. A carefully devised dormitory system, it is true, might not seriously menace the professional spirit of our students; but the establishment of such a dormitory system in proximity to Harvard College would involve exceptional difficulties. Upon the question of transportation it may be said that the means now existing and projected, together with the increased facilities that a demand would stimulate, make the location as accessible as might be expected of any place at a similar distance from the center of Boston.

On the other hand, our present site has contributed in no small degree to the distinct individuality of the Institute. This site, in a busy city, is by many regarded as one of our most valuable educational assets, and has great strategic advantages. Students can live in any of the surrounding suburbs, and can in general reach the Institute by one line of steam or electric cars without change, and are within walking distance of the railroad stations; and in like manner they can go from the Institute to engineering and industrial works in a wide circle of suburbs and neighboring towns. The central location attracts to our halls educational and engineering bodies that help to make a professional atmosphere, and assist in advertising the Institute to a scientific constituency of the utmost importance.

Lack of Definition of the Term 'Industrial Science,' as Bearing upon Instruction and upon Degrees.

In connection with the proposed alliance, much has been said of the avoidance of educational duplication; but the terms of the agreement as they stand fail to make it clear that any definite partition has been formulated, either in scientific instruction or in the granting of degrees in science. Nowhere is there a definition of the term 'industrial science,' upon the exact meaning of which these matters depend. The interpretations of the term which have been given to us, in so far as they make matters clear, imply that the intention is to consent to continued duplication in large elementary courses and in some advanced classes, rather than to attempt the unsound and impossible separation between pure and applied science. It has been explained to us that the intention is to continue in the Institute both instruction and the granting of degrees in such branches of pure science as chemistry, physics, geology, and biology. There is reason to believe that the University contemplates the retention of instruction and degree-giving in all these subjects, as well as the retention of elementary instruction in at least some branches of industrial science as College electives. The University also reserves its right to grant any and all degrees, in applied science as well as in pure science; but the agreement implies that Harvard degrees in applied science would hereafter be granted only upon the recommendation of the Faculty of the Institute. The Institute, on the other hand, seems to agree by implication to discontinue the granting of the Ph.D. degree, and of all degrees in other than 'industrial science,' which, as interpreted to us, is to include those branches of pure science, already mentioned, in which degrees are at present granted by the Institute. If, as would appear, the wording of Section XII. constitutes an abdication on the part of the Institute of the right to grant any degrees other than those specified, why should such an abdication be permissible on the part of the Institute when, as we are informed, the lawyers doubted whether the University could legally divest itself of a similar right?

Probability that the Earlier Years of Institute Work would be Absorbed by Harvard College.

Disaster to the integrity of the Institute's curriculum will, it seems to us, be the logical result of this lack of definition of the term 'industrial science,' when it is taken in connection with the fact that the College gives, and is likely to continue giving, elementary courses in mathematics, and in chemical, physical, and engineering subjects. It will be much more natural for a student intending to get an engineering degree to take his elementary work in the College. That such a result is anticipated by the framers of the agreement would appear from the statement of President Pritchett that the stronger technical schools are to take a forward step by which they will be free from much elementary work.

Two special causes are likely to contribute largely to this result. The first is that the tuition fee at Harvard is $100 less than that of the Institute. Even if the fees were to be equalized, at a serious financial loss to the Institute, there yet remains the second fact that participation in University athletics is open only to students enrolled at Harvard. Boys who are intending ultimately to become engineers, but who are also ambitious of athletic distinction, or even those who desire the real use rather than the partial privilege of the Harvard playgrounds, would be likely to take their elementary work in the College rather than in the Institute. Under existing conditions many parents prefer the professional atmosphere to the academic, and send their sons to the Institute rather for that reason than because they have any particular engineering career definitely planned for them. It can hardly be expected that this patronage would continue under the altered conditions now proposed.

Yet the most serious effect upon our curriculum, in consequence of such a change of methods, would be the loss of that absolute control over our instruction which we consider essential to the maintenance of our standards. If we turn over our elementary scientific work to another faculty, whose educational purposes and methods are essentially different from ours, we make impossible that close coordination of studies which we consider a prerequisite of successful technological education. Courses of elementary instruction, actually conducted by the Institute, not only give us a rule of comparison between the scientific preparation that is offered by students coming from other institutions and that which we desire and can insist upon, but they insure an advantageous uniformity of training to the great bulk of our students in those scientific studies which are the fundamentals of all technological education. We do not view any prospect of their abandonment with favor.

Sacrifice of Control.

A further disadvantage of the proposed agreement is the modification that it makes in the present method of government of the Institute. A new Executive Committee is created, of which at least three members out of nine shall be members of the Corporation of the University. It is our opinion that under this arrangement the 'organization, control, and traditions' of the Massachusetts Institute of Technology would not be so safeguarded as to inspire that confidence in the preservation of its individuality and in the continuance of its educational autonomy which we regard as absolutely essential to the well-being of the Institute and to the efficiency of its work. * * *

The Department of Architecture.

A thoroughly objectionable section of the agreement is that which excludes the Department of Architecture from its provisions, leaving the future of one of the original and one of the most brilliantly successful departments of the Institute wholly unsettled and problematical. * * *

Loss of Alumni Interest and Support.

Another disadvantage of the alliance is the danger that the interest and support of the graduates of the Institute will be sacrificed. An important element in the organic growth of an educational institution is a strong, well-organized association of its alumni, the men who can best appreciate the advantages and needs of the institution and who know the places where it can be strengthened. The Institute has such an Alumni Association, with local branches in all parts of the United States, and with a compact subsidiary organization in the form of an Association of Class Secretaries which has proved itself to be useful and efficient, and which promises to grow in importance. The alumni have shown a deep and enthusiastic loyalty, which has taken a practical form in subscription for the William Barton Rogers Scholarship Fund, the Walker Memorial Building, and, more recently and generously, for the Technology Fund. If the proposed alliance is accomplished, the interest of the alumni is sure to diminish with their diminished responsibility for the maintenance of the Institute, and may be altogether alienated. The loyalty of future graduates would at best be a divided sentiment.

Conclusion.

An institution which has passed beyond its formative period has a right, as a man has, to its own character and individuality. It has earned the right to grow and change along its own lines, and not to be violently wrenched out of them and made over, under new and untried influences, into something different from itself. Such a course might be justifiable as a desperate expedient in the case of a demoralized and decaying school. But the Institute is in no sense a decaying institution. While making no claim to perfection, it desires nothing so earnestly as a fuller and richer though not necessarily a larger growth.

In point of numbers, however, the Institute, despite a steady increase in its requirements for admission and an exceptionally high tuition fee, is more than holding its own, not only in Massachusetts, but throughout New England, and not only in New England but throughout the United States. Our defects—and no one is more conscious of them or more desirous to amend them than is the Faculty—are in part consequences of growth and of success. In part, however, they are inevitable defects of the qualities which have made us what we are. The lack of academic leisure and of monumental college surroundings, and the absence of a great part of the social and athletic life of the typical American college,—such losses are a necessary price which we and our students pay for the spirit of professional study, of business-like regularity, and of scientific accuracy. In the training of engineers we believe that these qualities are worth vastly more than the desirable things which we sacrifice in order to obtain them. While continuing to insist upon these qualities, we shall be glad, so far as we can safely do so, to diminish their defects. But we believe that we can best accomplish this by remaining free to deal with the problem by methods under our own control. With that high regard for the spirit of university life to be expected from a body of men more than half of whom, as is the case with this Faculty, have received their training from colleges and universities, rather than exclusively from technological schools, we are nevertheless firmly convinced that the effect of direct contact and intermingling of our student body with the dormitory, social, and athletic life of college undergraduates, under the conditions obtaining in this case, would be more harmful than beneficial, and that it would be little less than totally destructive of the established character and atmosphere of the Institute.

A successful and valuable school quite different from ours might no doubt be developed under university conditions, but that would much better be done independently, from such beginnings as already exist, rather than upon the basis of our reputation and at the cost of our individuality. With institutions, as with men, character is a thing which may be undermined and destroyed, but which can not be bought or sold or transferred. The success of the Institute thus far has surely not been due to its wealth, to its superior equipment, or to large salaries paid to its instructing staff. Its success has been and still is a success mainly of character and morale; and it is precisely these vital qualities which the Faculty believes would be destroyed by the changes called for under the terms of this proposed agreement. For it is not merely proposed to remove the Institute to a new site, but to graft it upon another institution.

Very grave questions of policy would at once confront the new Executive Committee in the problems arising from removal and from the establishment of an entirely new type of life among our students, and from the adjustment of working relations with the University. The controversies and differences within the Committee to which these questions would give rise, and ought to give rise, might under this agreement lead at any time to one of two things:— the rupture of the agreement, or the transfer to the University of a complete control over the working Institute by the election of a majority instead of a minority of the joint Executive Committee from the membership of the University Corporation. The adoption of this agreement would therefore plunge the Institute at once into a condition of uncertainty concerning the preservation of its individuality and control,—an uncertainty probably more prejudicial to its organic development than an immediate and entire surrender of control would be. Even the full assent of the Institute to the proposed agreement would not make it certain that the project is to be carried out. It would have still to receive the sanction of the University, the ratification of the Overseers, and to await indefinitely various legal proceedings and decisions. All these contemplated delays and uncertainties would be further augmented by such other contingencies and delays as must necessarily arise in carrying out so vast and complex an undertaking. This period of uncertainty, extending inevitably over five or six years, would be most prejudicial to the educational work and to the educational prestige of the Institute.

In closing, the Faculty is glad, in accordance with a request made by the President, to take this opportunity to state that it fully believes in the possibility of cooperation in effort between Harvard University and the Institute, and trusts that this may be secured in the future to as great an extent as practicable. There are necessarily limitations to such cooperation, but we are convinced that it is possible, by consultation and conference, to secure a cooperation thus limited which will prove beneficial to industrial education in general, as well as to the particular work of both institutions. By the more frequent interchange of instructors, by allowing to the advanced students of each institution such privileges of instruction in the other as may be practicable, by the common use of valuable apparatus, by the participation in University and Institute seminars of instructors and students of both institutions, by giving advanced courses of lectures to the combined classes of both institutions; perhaps by mutual agreement from time to time to relegate certain branches of instruction to one of the two; by carrying out together advanced engineering researches and tests,—by these, and by various other ways that will suggest themselves, much may be accomplished in harmonious effort which should be highly beneficial to both the University and the Institute. This development, however, must be a growth. It can not be forced, as the proposed agreement would attempt to force it, for it is in the nature of continuous experiment, presenting problems for the solution of which no data exist.

SCIENTIFIC BOOKS.

Madreporaria, Parts III. and IV. By J. Stanley Gardiner, M.A., etc. (From 'The Fauna and Geography of the Maldive and Laccadive Archipelagoes,' Vol. II., Supplement I., pp. 933–957, pls. LXXXIX–XCIII.)

The first installment of Mr. Gardiner's report on the Madreporaria from the Maldive and Laccadive Archipelagoes has already been reviewed in the columns of this journal.* The second installment, which has just been received, contains an account of the Fungida and Turbinolidæ.

* Vol. XX., No. 511, pp. 503–505, October 14, 1904.

III. Fungida.—548 specimens, besides a number of young forms and fragments, were obtained. These are divided into 27 species and 2 varieties, representing 15 genera; against 24 species and 9 genera reported by Klunzinger from the Red Sea, and 15 species and 7 genera found by the author in the Pacific.

The following is a list of the genera with the number of species referred to each, and the names of the forms considered new: *Psammoseris*, 1; *Siderastrea*, 4, *S. maldivensis*, nov.; *Agaricia*, 1, *A. ponderosa*, nov., + var. *minikoiensis*, nov.; *Fungia*, 3; *Podobacia*, 1; *Halomitra*, 1; *Herpetolitha*, 1, *H. simplex*, nov.; *Cycloseris*, 2; *Diaseris*, 1; *Pavonia*, 1; *Leptoseris*, 3, *L. incrustans*, nov.; *Echinophyllia*, 1; *Pachyseris*, 1; *Coscinaræa*, 2, *C. donnani*, nov.; *Psammocora*, 4; *P. divaricata*, nov.

Mr. Gardiner does not follow von Marenzeller in referring *Stephanoseris* to the synonymy of *Heterocyathus* and *Psammoseris* to that of *Heteropsammia*, but combines *Stephanoseris* and *Psammoseris* under the latter name. He goes further and puts the type species of *Psammoseris* (*P. hemispherica*) in the synonymy of the type species of *Stephanoseris*, which was originally described as *Heterocyathus roussæanus*.

I somewhat doubt the correctness of the generic determination of *Siderastrea clava*, *S. lilacea* and *S. maldivensis*. Mr. Gardiner calls attention to these 'having in their surface parts the thecæ of neighboring calices quite separate from one another, joined together only by costæ, instead of fused together into a single dividing wall.' This difference did not escape his attention.

Mr. Gardiner himself doubts his *Agaricia ponderosa* really being an *Agaricia*. I feel rather confident that it is not an *Agaricia*. The type species of the genus is *A. undata* (Ell. & Sol.) Lamk; the type specimen is in the Hunterian Museum, Glasgow, where I have seen it and Professor J. Graham Kerr has kindly sent me photographs. The genus can be briefly characterized as follows: *Corallum* compound, thin, foliaceous. *Common wall* imperforate, naked, finely striate; no differentiated corallite walls. *Calices* forming more or less definitely concentric series, which are bounded below by a subcalicular swelling or ridge; there is no swelling or ridge above, the septo-costæ running directly to the next series. Septa well developed, distinctly radiate, imperforate. *Columella* a single tubercle. *Agaricia fragilis* (Dana) agrees in generic characters with the type and is a closely related species.

I think that Mr. Gardiner's criticism of Professor Döderlein's monograph, 'Die Korallengattung Fungia,' is in some respects too severe. He says: "It is quite clear that that author [Döderlein] has, generally speaking, no scientific basis for his description of 'varieties.'" The word variety is difficult to define in a manner that will be satisfactory to all systematists, and Mr. Gardiner himself is guilty of an inconsistency. Under *Fungia dentigera,* he speaks of 'a true variety, the separating characters of which are discontinuous.' If the characters are discontinuous, the specimens belong to a distinct species. Mr. Gardiner in Part I. of his 'Madreporaria of the Maldives and Laccadives' says 'discontinuous or specific' variation. Variation in corals is so complex and its causes are so little understood that one should be very lenient in criticizing the efforts of a fellow worker to handle its phenomena. There are mistakes in Döderlein's work; some of his varieties can not be maintained by any of the usually accepted canons of zoological nomenclature, but his work is earnest and he has much advanced our knowledge of the genus *Fungia.*

I am glad to see that Mr. Gardiner considers *Podobacia* a valid genus, and heartily agree with him in that course.

As regards *Cycloseris* and *Fungia,* I agree with Döderlein. The only possible basis for their separation into two genera would be in *Cycloseris* having originally only six primary septa and *Fungia* twelve. The validity of this character is extremely doubtful, as it rests on a very slim foundation.

Without entering into a discussion of my reasons, I will state that I believe Quelch was correct in uniting *Cycloseris* and *Diaseris,* and, as stated in what precedes, I agree with Döderlein in combining both with *Fungia.*

IV. Turbinolidæ.—The number of specimens collected is not given. Six species, representing 4 genera, are referred to the Turbinolidæ. They are *Flabellum,* 2, *F. multifore,* nov.; *Tropidocyathus,* 1, *T. cooperi,* nov.; *Heterocyathus,* 1; *Paracyathus,* 2.

Mr. Gardiner's paper is an important contribution to the literature of reef corals. He gives valuable notes on variation, careful descriptions and figures all the forms described as new and several of those referred to previously described species.

The studies being made on the coral faunas of the Pacific and Indian oceans are bringing out many interesting facts of their geographical distribution. I have just completed a study of the Hawaiian Fungida, and may be pardoned for comparing them with those from the Indian Ocean. The following is a list of the species, with notes on their occurrence elsewhere: *Fungia* (*Cycloseris*) *patella* (Ell. & Sol.), east coast of Africa, etc.; *Fungia* (*Diaseris*) *fragilis* (Alcock), Indian Ocean; *Fungia scutaria* var. *dentigera* Leuckart, Indian Ocean, etc.; [*Fungia oahensis* Döderlein; *Fungia paumotensis* Stutchb. (*fide* Quelch), Philippines, etc.; *Fungia echinata* (Pallas) (*fide* Studer)]* Indian Ocean, etc.; *Bathyactis stephana* Alcock, Indian Ocean; *Stephanaria stellata* Verrill, Panama; *Stephanaria* n. sp.; *Pavona varians* Verrill, aff. *P. repens* Brüggemann; *Pavona* n. sp.; *Leptoseris* (1) n. sp., aff. *L. fragilis* M. Ed. & H.; *Leptoseris* (2) n. sp.; *Leptoseris* (3) n. sp., aff. *L. papyracea* (Dana); *Leptoseris* (4) n. sp.; *Psammocora,* aff. *P. superficialis* Gardiner.

A fair proportion of the species actually occur in the Indian Ocean, some as far west as Africa, or have there analogues so similar that specific separation is doubtful. As would be expected, the Panamic fauna is represented to some extent.

T. WAYLAND VAUGHAN.

May 15, 1905.

* I have not seen specimens of these from the Hawaiian Islands, but the type of the first is from there.

SOCIETIES AND ACADEMIES.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

The twelfth meeting of the Society for Experimental Biology and Medicine was held in the laboratory of clinical pathology of the Cornell University Medical College, on Wednesday evening, May 24. The Vice-President, Edward K. Dunham, was in the chair.

Members present.—Atkinson, Auer, Brooks, Burton-Opitz, Crampton, Davenport,* Dunham, Emerson, Ewing, Field, Flexner, Gies, Herter, Levene, Levin, Lusk, Meltzer, Mendel,* Morgan, Noguchi, Norris, Oertel, Opie, Richards, Salant, Sweet, Torrey, Wallace, Wolf.

Members elected.—Joseph Erlanger, E. O. Jordan, Otto Folin.

ABSTRACTS OF REPORTS OF ORIGINAL INVESTIGATIONS.†

Contributions to the Study of Sulfur. I. The Metabolism in Brombenzol Poisoning: W. Mackim Marriott and C. G. L. Wolf.

Administration of brombenzol to dogs resulted in increased elimination of nitrogen and urea. Urea closely followed total nitrogen. Preformed ammonia was decreased. Creatinin elimination was not appreciably affected. Total sulfur excretion was not increased, but there was almost complete suppression of alkali sulfates. Excretion of neutral sulfur, represented for the most part in this case by parabromphenyl-mercapturic acid, was increased 400 per cent. Ethereal sulfate elimination was markedly increased. Total sulfate-sulfur was diminished. Excretion of chlorin and phosphorus was practically unaffected. Nitrogen and fat were increased in the feces. The drug caused ulceration of the stomach and intestines, and degeneration of the liver and kidneys.

* Non-resident member.

† The abstracts presented in this account of the proceedings have been greatly condensed from abstracts given to the secretary by the authors themselves. The latter abstracts of the reports may be found in current numbers of *American Medicine* and *Medical News.*

On Experimentally Produced Variations in the Energy of Tumor Growth: Leo Loeb. (Presented by James Ewing.)

The author's observations point to the general conclusion that it is possible to cause an experimental increase or decrease in the energy of tumor growth. Such variations may be brought about by direct stimulating or depressing influences on the tumor cells. The stimulation effects may become cumulative.

Demonstration: Photographs and Plumage-charts of Hybrid Poultry, with Remarks: Charles B. Davenport.

Dr. Davenport exhibited photographs and plumage-charts of four hybrids between different races of poultry, and also of their parents, and remarked on the nature of the inheritance illustrated by each example.

Experimental Cirrhosis of the Liver: Richard M. Pearce. (Presented by Eugene L. Opie.)

Necrotic lesions were produced in the liver of the dog by injections of hemolytic immune sera of high hemagglutinative power. The author's observations have demonstrated that cirrhosis may follow extensive primary destructive lesions produced in this way (a view not yet fully accepted) and thus support the contention of Kretz that cirrhosis is essentially the result of a series of repair processes following repeated injuries of liver parenchyma.

Experimental Arteriosclerosis: Richard M. Pearce and E. McD. Stanton. (Presented by J. E. Sweet.)

Intravenous injections of adrenalin produce in rabbits vascular lesions that are limited to the aorta and that exhibit more or less definite sequence. Five to six injections of 3 to 25 minims of 1–1,000 solutions every 24–48 hours for long periods cause at first histologically important changes in the media. After about 12–15 injections very definite lesions are evident macroscopically. In the experiments continued for 6–8 weeks, the process becomes very diffuse and small dilations of the thinner portions of the aorta assume the appearance of aneurisms. At this stage the destruction of the elastic fibers is extreme and all degenerated areas are infiltrated with calcium salts.

Whether the vascular changes are due to a primary toxic action of the adrenalin or whether they are the result of the increased arterial tension which it causes, has not been determined.

On the Chemical and Physiological Properties of Ricin, with Demonstrations: THOMAS B. OSBORNE and LAFAYETTE B. MENDEL.

The most active preparation proved fatal when administered subcutaneously to rabbits in the small dose of 0.0005 *milligram* per kilo of body weight. The toxic constituent of the castor bean appears to be an *albumin.* Ricin is like other albumins in composition, heat coagulation, color reactions, precipitation reactions, specific rotation, state of combination of its nitrogen, etc. By tryptic digestion the agglutinating power of pure ricin may be greatly impaired or destroyed. The experience of the authors lends no encouragement to attempts to 'purify' such toxins by methods designed to eliminate proteid substances from the active materials.

On a Method of Determining Indol, with Demonstrations: C. A. HERTER and M. LOUISE FOSTER.

The authors described a rapid and accurate means of determining indol. It is based on the fact that indol, in slightly alkaline solution, readily condenses with naphthoquinon sodium mono-sulfonate and forms a *blue* crystalline compound that is only very slightly soluble in water but is readily extracted by chloroform from a watery solution or suspension. The condensation product is di-indyl naphtho-ketone mono-sulfonate. Its solution in choloroform is *red.* The method is well adapted for colorimetric or gravimetric determinations.

Anesthesia Produced by Magnesium Salts, with Demonstrations. A Preliminary Communication: S. J. MELTZER and JOHN AUER.

The authors exhibited two guinea pigs which were deeply narcotized by subcutaneous injections of magnesium sulfate. One of these animals had been similarly narcotized twice before and fully recovered each time. If the dose of magnesium salt is not too large, heart beat, blood pressure and respiration remain nearly normal during periods of narcosis in which any operation can be performed without resistance. Certain maximum doses can not be exceeded without causing extremely toxic effects.

Enzymes and Anti-enzymes of Inflammatory Exudates: EUGENE L. OPIE.

Inflammatory exudates removed from the pleural cavities of dogs one or two days after injection of the irritant (aleuronat) undergo very little change, while those removed three or more days after the onset of inflammation exhibit appreciable though slight autolysis. There is no relation between the amount of digestion and the number of cells which are present. The serum inhibits autolysis in a suspension of the cells separated by centrifugalization. The antilytic action of the serum is favored by an alkaline reaction, but is completely prevented in an acid medium. The serum of the exudate contains a proteolytic ferment which is active only in an acid medium. In the later stages of such inflammations there is some diminution of the antilytic power of the exudate.

Shallow Well Waters of Brooklyn: JAMES P. ATKINSON.

The author's observations justify the conclusions that the sandy soil of Brooklyn can not be relied upon as a safe filter for the well waters of that borough, that Brooklyn soil in populous districts seems to be nearing the saturation point for sewage, and that many of the shallow wells in Brooklyn are, therefore, in growing danger of serious pollution.

The Influence of the External Temperature upon the Viscosity of the Blood: RUSSELL BURTON-OPITZ.

The author has found that the viscosity of the 'living' blood can be greatly influenced by changing the external temperature. Viscosity was markedly increased in dogs immersed in water at 25° C. Warm water baths (42°–45° C.) produced a corresponding decrease in the viscosity. Specific gravity of the blood showed corresponding variations.

The Changes in the Viscosity of the Blood during Narcosis: Russell Burton-Opitz.

It was found that the viscosity of the blood is increased by *deep* ether or chloroform narcosis and lessened during light anesthesia. Specific gravity of the blood was increased by deep and lessened by light ether narcosis. Chloroform, on the other hand, produces a slight decrease during deep and an increase during light narcosis. Hence the specific gravity can not be regarded as a perfectly accurate index of the viscosity.

Studies of the Effects of Radium on Plants and Animals, with Demonstrations: Communicated by William J. Gies.

I. Preliminary notes on the effects of radium rays on plants. C. Stuart Gager. Plants are stimulated. For this stimulus there are minimum, optimum and maximum points, depending upon the proximity of the radium to the plant, the strength, quantity and condition of the radium salt, the time of exposure and the nature and condition of the tissue.

II. The action of radium rays on *Amœba proteus* and upon other microorganisms. Louis Hussakof. No visible effects were produced, by even the strongest radium preparations, during periods of observation of about an hour. The water surrounding the animal in each experiment may have prevented radiant effects.

III. The effects of intravenous injections of radium bromid. Russell Burton-Opitz and G. M. Meyer. Increased blood pressure, caused by general vasoconstriction, always promptly followed injection of radium preparations in small dogs. This effect was soon followed by a fall of pressure, due to decrease in frequency and accompanied by irregularity of the heart. The variations in blood pressure were extreme. These effects occur after division of both vagi. Respiration gradually decreases in frequency until respiratory paralysis results. A striking *qualitative* similarity was found to exist between the effects of pure barium bromid and radium bromid preparations of low activity (240 and 1,000). Radium bromid of 10,000 activity, however, differed from barium bromid in failing to cause irregularity in the action of the heart. Quantitative differences were also noted.

IV. The radioactivity of the different organs after intravenous injections of radium bromid. Gustave M. Meyer. Thus far determinations have been made only on the dogs used in the experiments of Burton-Opitz and Meyer (III). Practically all parts except the brain were found to be radioactive. The blood always manifested the greatest radioactivity.

V. The influence of radium bromid on metabolism in dogs. William N. Berg and William H. Welker. Feeding experiments have thus far failed to show appreciable results, except an increase in elimination of total sulfate in the urine.

William J. Gies,
Secretary.

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

At the meeting of April 3, 1905, Professor Stevenson presiding, the following papers were read:

The Physiography of the Adirondacks: J. F. Kemp.

The Adirondacks cover some 10,000 square miles, and except for the White Mountains of New Hampshire and the Blue Ridge of North Carolina, are the loftiest summits east of the Black Hills of South Dakota. They are metamorphosed Precambrian sediments and eruptives with a surrounding fringe of Paleozoics beginning with the Potsdam and ending with the Utica, except for the Glacial drift. The eastern portion is mountainous, the western a high plateau which slopes to Lake Ontario. Three peaks exceed 5,000 feet. The general profile of the mountains is serrate, but there is great variety of shape. There are two contrasted types of valleys. One type, doubtless an instance of greater geological antiquity, presents gentle slopes and great maturity of form. Its members run east and west, and north and south, and are occupied in some cases by the larger lakes.

The second type is more recent, and is due to faulting. The valleys have on one or both sides precipitous escarpments. The cliffs run northeast and southwest or northwest and southeast. A third series of breaks running nearly due north is also at times in evidence. The faults are most often the result of differential movements causing even a marked sheeting of the rocks. The faults run out into the Paleozoic areas, and are shown with diagrammatic distinctness, where they have been especially described by H. P. Cushing.

The problem of the drainage is of especial interest. All the waters go ultimately either to the Hudson or the St. Lawrence. The courses of the large streams follow sometimes the older type of valleys, sometimes the later. Barriers of drift have often driven them from their old lines across low, preglacial divides into new ones. The courses of the Hudson and Onondaga are particularly striking illustrations, each exhibiting one or more marked bends to the eastward. The courses of the two were described and discussed in some detail.

The different types of lakes were also described including the river valleys ponded by barriers of drift, the fault valleys and the relations to the older type of depression.

The nature of the ice invasion and its modifying effects were passed in review, chiefly along the work of I. H. Ogilvie. With a brief statement of the Post-glacial lake-fillings, etc., which have been especially set forth by C. H. Smyth, Jr., the paper closed.

The Paleogeography of Mid-Ordovicic Time: CHARLES P. BERKEY.

Both the Cambric and Ordovicic formations contain prominent sandstone strata alternating with dolomites wherever exposed in Michigan, Wisconsin, Minnesota, Iowa, Illinois, Missouri, Arkansas and Indian Territory. The northern margin, however, is prevailingly more arenaceous than the southern, where shales replace many sand beds. At still greater distance, in Ohio, Kentucky and Tennessee, these are in turn represented by limestones largely.

The uppermost one of the series is the St. Peter. This sandstone, as well as each of the more important ones below, is believed to represent an extensive retreat and re-advance of the sea. Few marks of the erosion intervals are preserved. Only here and there has the mantle of sand permitted much attack upon the underlying dolomite, and the reworking of the sands themselves has obliterated most internal evidence of such history.

Much of the sand, furthermore, is windblown. This reworking by the sea and the wind is believed to be the chief cause of the extreme purity of the St. Peter.

The St. Peter stage of the Ordovicic, therefore, represents a retreat of the Mississippian sea from the vicinity of Lake Superior to probably as far as Ohio, southern Illinois and Arkansas, followed by a readvance to its original position. The northern part of the St. Peter contains a sedimentary break. In part it is both older and younger than the same formation in its southern extension, while, on account of the reworking accompanying the sea advance, there is greater conformity with overlying than with underlying beds.

A. W. GRABAU,
Secretary.

AT the meeting of May 1, 1905, Vice-President Hovey presiding, the following papers were read:

The Pleistocene Beds of Sankaty Head, Nantucket: J. HOWARD WILSON.

When visited by early explorers, the section at this locality was kept freshly exposed by the cutting back of the bluff by the sea, but for quite a period of years this has been prevented by the northward extension of the Siasconset apron beach, so that the face of the bluff is now covered with talus and overgrown with beach grass.

The locality was visited during the summer of 1904 and considerable work done in exposing the section and making a collection of the fossils.

This work resulted in the collection of 81 species, 21 of which had never been reported from this point, including *Pandora crassidens* Conrad not previously found in any horizon above the Miocene, and *Serripes laperonsii* Deshayes and *Macoma incongrua* Von Mar-tens belonging to the Arctic fauna of the Pacific coast and not heretofore reported east of Point Barrow.

A number of facts differing somewhat from those reported by former observers were noticed and have resulted in a somewhat different interpretation for the phenomena presented by these deposits.

The deposits are not of glacial origin, for (1) numerous delicate and unworn shells occur; (2) bivalves such as *Solen, Venus* and *Mya* occur in the position in which they lived with both valves together, and in the case of *Venus*, with the ligament in place; (3) the faunas are not mixed as would be the case if of glacial origin, the lower beds containing shoal-water species of a southern range, and the upper, deeper water species of a northern and even Arctic type.

The lower beds were deposited in a shallow inlet or lagoon, as shown by such species as *Mya, Ostrea* and *Venus* and especially by numerous mud crabs and the presence of our edible crab, *Callinectes sapidus*, while the upper beds were deposited during a subsidence of the area contemporaneous with the advance of the Wisconsin ice sheet, as shown by the deeper water and more northern species.

After the destruction and washing into the lagoon of the protecting barrier beach, as shown by the overlying rounded and pure, white sands, the ice reached and passed this point, eventually burying the beds under fifty feet or more of drift. Later, a reelevation took place, bringing the land to about its present position.

Early Stages of some Paleozoic Corals: C. E. Gordon.

J. E. Duerdon in the Johns Hopkins University Circular for 1902 has endeavored to show by studies based on *Lophophyllum proliferum* that the Rugosa exhibit a hexameral plan of growth of the primary septa, in so far as *L. proliferum* may be taken as representative. Certain studies on *Streptelasma profundum* show a primary tetrameral plan. The fact that *S. profundum* is a middle Ordovicic type suggests that this is the primitive condition. Moreover, a careful examination of Duerdon's figures shows that they lend themselves to an entirely different interpretation from that which Duerdon gives. This interpretation is that two of the so-called primary septa are secondary septa precociously developed; that their sequence and ultimate position are the same as those for the secondary septa which appear in the corresponding positions in the corresponding quadrants of a zaphrentoid coral; that the fossula and cardinal septum are on the concave side of the corallum; and that if Duerdon's figures be inverted they reveal a perfect similarity to a zaphrentoid coral, as far as the order of appearance and the arrangement of the septa are concerned.

The fact that *L. proliferum* is of Carbonic age indicates that it is a modified type of the zaphrentoid coral, the first secondary septa appearing in nepionic stages and thus simulating the character of primary septa.

A New Lower Tertiary Fauna from Chappaquiddick Island, Martha's Vineyard: Thomas C. Brown.

A few years ago while studying the Cretacic deposits of Long Island, Block Island and Martha's Vineyard, Dr. Arthur Hollick made a collection of fossil molluscs and plants from Chappaquiddick Island. The fossil molluscs were deposited in the Columbia University collection without being fully and carefully studied.

These fossils occur in the island in ferruginous concretions. They seem to have been deposited somewhere to the north of where they are now found, then moved as glacial drift, reassorted and deposited in their present position. From their lithological similarity to concretions containing undoubted Cretacic fossils found elsewhere on Martha's Vineyard, Dr. Hollick thought that these concretions and their contained fossils must be of Cretacic age.

Professor Shaler noted the occurrence of these concretions and their similarities to the Cretacic drift, but being unable to find any distinctive organic remains hesitated to set them down as Cretacic.

Professor R. P. Whitfield considered that these rocks could hardly be Cretacic, since the fossils were of a more recent type.

A careful study of the fossils has shown that this material is not Cretacic but Eocene in age. This fauna from Chappaquiddick represents a new and distinct Eocene province, differing from all the other Eocene provinces of the Atlantic coast, but no more widely different from these than they are from one another. Although in this fauna there are several species somewhat resembling those of the provinces to the south, on the whole it would seem to be more closely allied to the Eocene of England. The genera most abundantly represented in these Chappaquiddick deposits, *e. g.*, *Modiola*, *Glycymeris*, are also among the most abundant in the English deposits. These same genera, although represented in the Atlantic and gulf provinces, are there more sparsely distributed and occur with other more abundantly represented genera that appear to be altogether wanting in the Chappaquiddick deposits.

A comparison of this Chappaquiddick fauna with other Eocene faunas indicates that it is of lower Eocene age, the species most closely resembling those found in this fauna being found in the lower beds of the Atlantic and gulf provinces, the Tejon of California and the lower beds of England. These deposits may possibly be of the same age as the Shark River beds of New Jersey, but being deposited in a region separated from this have no forms in common with it. But such correlation could be only conjecture. As the correlation of the well-known Eocene deposits is even yet very uncertain it is unnecessary and impossible to place these beds any more definitely than simply to say that they are Lower Eocene.

Structural Relations and Origin of the Limonite Beds at Cornwall, N. Y.: C. A. Hartnagel.

The limonite at the Townsend iron mine, near Cornwall in Orange County, N. Y., is found at the base of the New Scotland beds where the latter are in contact with the Longwood red shales. The source of the iron is evidently from the red shales but whether the contact was due to overlap or faulting has not been previously explained. Two thirds of a mile north of the mine the Decker Ferry, Cobleskill, Rondout, Manlius and Coeymans formations, having a total thickness of 95 feet, are found between the New Scotland and Longwood beds. In the region of the mine the strata are nearly vertical and in faulting a wedge-shaped block was forced up, bringing the red shales in contact with the New Scotland beds. A cap of limestone has until recent geologic times protected from erosion the mass of soft Longwood shales which now form a steep hill, but which is rapidly being worn away.

Types of Sedimentary Overlap: A. W. Grabau.

With a normal sea shore, a rising sea level will produce the phenomenon of progressive overlap, a falling sea level that of regressive overlap. If the sea transgresses slowly, and the rate of supply of detritus is uniform a basal rudyte or arenyte is formed which rises in the column as the sea advances, and whose depositional off-shore equivalents are successive beds of lutytes or organic deposits (biogenics). Types of such basal beds which pass diagonally across the time scale, are seen in the basal Cambric arenytes of eastern North America, which as the Vermont Quartzite are lower Cambric, and as the Potsdam are Upper Cambric. Again in the Basal Cretacic arenyte of southwestern United States, this is shown, these being basal Trinity in Texas, Washita in Kansas, and Dakota or later on the Front Range. Examples of this type of progressive overlap are numerous and familiar. On an ancient peneplain surface the transgressing sea may spread a basal black shale, as in the case of the Eureka (Noel) Black shale, which is basal Choteau in southern Missouri and basal Burlington in northern Arkansas. Regressive movements of the shore succeeded by transgressive movements give us arenytes which are enclosed in offshore sediments and which within themselves comprise an hiatus the magnitude of which diminishes progressively away from the shore. An example of this has recently been discussed by Berkey* who finds that the St. Peter Sandstone in Minnesota marks the interval from

* See *ante*, April meeting.

lower Beekmantown to upper Stones River, which interval is represented by several thousand feet of calcareous sediments in other regions distant from the shore of that time.

In marine transgressive overlaps, later members overlap earlier ones toward the source of supply, *i. e.,* towards the old-land. In non-marine progressive overlaps, later members overlap the earlier ones away from the souree of supply. Thus in a growing alluvial cone, the later formed beds will extend farther out on to the plain away from the mountain. If several successive fans of this type are formed one above the other, owing to successive elevations of the source of supply, only the latest beds of eaeh delta will be found on the outer edge of this compound delta, the hiatus between the beds being further emphasized by the erosion which the last bed of the first delta underwent during the time that the early beds of the second delta were deposited nearer the source of supply, *i. e.,* before the last bed of the second delta covered up the remnant of the last bed of the first delta and thus proteeted it from further erosion. A good example of this type of overlap appears to be presented by the Poeono, Mauch Chunk and Pottsville beds of the Appalachian region. These formations are with exception of the negligible Greenbrier member, of non-marine origin, representing the wash from the growing Appalachians. In western Pennsylvania only the latest beds of each (barring portions removed by erosion between the deposition of the successive fans) are found resting one upon the other, the interval between the beds beeoming less and less toward the anthraeite regions.

A. W. Grabau,
Secretary.

SECTION OF BIOLOGY.

At the April meeting Professor H. F. Osborn presented a discussion of 'The Ideas and Terms of Modern Philosophieal Anatomy,' and Dr. O. R. Hay described 'Turtles of the Bridger Basin.' The full abstract of Professor Osborn's paper was published in Science for June 23. Dr. Hay gave a brief description of the extent of the Bridger beds and of the nature of the materials composing them. He expressed the conviction that these deposits had not been made in a lake, but over the flood-grounds of rivers. The region was probably covered with forests, and teemed with animal life. In the streams were numerous turtles. Many species of these have been described by Dr. Leidy and Professor Cope. In the speaker's hands are materials for the description of about a dozen more species. The American Museum party of 1903 collected many speeimens of the genus and these have furnished good skulls, neck, shoulder and pelvie girdles, and the limbs. These materials confirm the validity of Lydekker's group called Amphichelydia, and show that from it sprang the modern super-families Cryptodira and Pleurodira.

At the May meeting of the section papers were presented by Professor E. B. Wilson on 'Observations on the Chromosomes in Hemiptera,' and by Professor H. E. Crampton on 'Correlation and Selection.'

Professor Wilson's paper presented the results of an examination of the mode of distribution of the ehromosomes to the spermatozoa in *Lygæus turcicus, Cœnus delius, Podisus spinosus* and two speeies of *Euchistus.* In none of these forms is an aecessory chromosome (in the ordinary sense) present, all of the spermatozoa receiving the same number of chromosomes, whieh is one half the spermatogonial number (the latter number is in *Podisus* sixteen, in the other forms fourteen). In all these forms, however, an asymmetry of distribution occurs such that two classes of spermatozoa are formed in equal numbers, both receiving a ring of six chromosomes (in *Podisus* seven) that are duplicated in all the spermatozoa, and in addition a central one which in one half the spermatozoa is much smaller than in the other half. These eorresponding but unequal chromosomes (which evidently correspond to some of the forms described by Montgomery as 'chromatin nucleoli,' and agree in mode of distribution with that which this author has described in the case of *Euchistus tristigmus*) may be called the 'idiochromosomes.' They always remain separate in the first division, which aceordingly shows one more than one half the spermatogonial number of chromosomes, but at the close of this division conjugate to form an asymmetrical dyad, the number of separate chromatin-elements being thus reduced from eight to seven (in *Podisus* from nine to eight). A reduction of the number to seven in the first division, such as has been described by Montgomery as an occasional or usual process in *Euchistus* and *Cœnus*, was never observed. In the second division the asymmetrical idiochromosome-dyad separates into its unequal constituents, while the other dyads divide symmetrically. One half the spermatozoa, therefore, receive the large idiochromosome and one half the small, the other chromosomes being exactly duplicated in both.

Correlated with this asymmetry of distribution is the fact that the spermatogonial chromosome-groups do not show two equal microchromosomes (as is the case in such forms as *Anasa, Alydus* or *Protenor,* where an accessory chromosome is present) but only one, which is obviously the small idiochromosome, the large one not being certainly distinguishable at this period from the other spermatogonial chromosomes. The final synapsis of the idiochromosomes is deferred to the prophases of the second division, somewhat as that of the two equal microchromosomes is deferred until the prophase of the first division in *Anasa, Alydus* and some other forms. A remarkable result of the difference in this regard between the forms that possess and those that lack a true accessory chromosome is that in the former case (*Anasa, Alydus,* etc.) the first division of the small central chromosome is a reduction-division and the second an equation-division; while in the latter case (*Lygæus, Cœnus,* etc.) the reverse order manifestly occurs. The relation of these observations to earlier ones by Paulmier, Montgomery and others was pointed out, with a discussion of their bearing on the Mendelian phenomena of heredity and the problem of sex-determination.

Professor Crampton presented briefly some of the conclusions drawn from the results of his work upon variation, correlation and selection among saturnid lepidoptera. The earliest studies showed that eliminated individuals, when compared with similar members of the same group that survive, prove to be more variable and of somewhat different types, although this relation between variability and selection is not a constant one. The characters utilized for these preliminary studies, namely, certain pupal dimensions and proportions were of such a nature that they could not serve the pupa directly in any functional manner, wherefore it was concluded that their condition of correlation formed the actual basis for the selective process, formative correlation being also distinguished from functional correlation. That the general condition of correlation among the structural characters of pupæ formed, indeed, the basis for selection was further indicated by the results of a statistical study of the correlations between various characteristics of pupal groups from several different animal series; although an advantage did not always appear in favor of the surviving group. On the basis of the foregoing, a general theoretical conception was developed, according to which the whole series of internal elements and the whole series of external influences were regarded as involved in the determination of the general condition of correlation or coordination that formed the basis for selection, as adaptive or the reverse.

M. A. BIGELOW,
Secretary.

DISCUSSION AND CORRESPONDENCE.

PRE-PLEISTOCENE DEPOSITS AT THIRD CLIFF, MASSACHUSETTS.

TO THE EDITOR OF SCIENCE: It has been suggested by several writers (Shaler and Verrill) that Tertiary and Cretaceous deposits may occur on the floor of the sea north of their known occurrence on Marthas Vineyard and Cape Cod. Their northerly occurrence on land has not been noted except for the Miocene greensands at Marshfield, Mass. (Duxbury sheet, U. S. G. S.). During the spring field season at Harvard University the writer reexamined the coast from Boston Harbor to Peaked Cliff, fifteen miles southeast of Plymouth harbor, in order to test, by means of the excellent cliff sections, the suggestion of the occurrence of such deposits. Pre-Pleistocene deposits were found at Third Cliff, twenty miles southeast of Boston, and possibly at Peaked Cliff, southeast of Plymouth.

The section at Third Cliff shows yellow clays at the base conformably overlain by yellow and white sands and succeeded by a bed of bright red sands with an unconformity at their base. On the eroded edges of the red and white beds are deposited dark, glauconitic and lignitic clays and sands. The entire series of beds has a total maximum thickness of sixty or seventy feet, and outcrops for a half mile along the cliff face. Absolutely no erratic material occurs either within the beds themselves or along the lines of unconformity.

The lithologic characters of the lower beds are like those so persistently characteristic of the Cretaceous from Marthas Vineyard to New Jersey; while the upper beds of dark clays appear to be homologues of the Miocene at Gay Head and at Marshfield. This fact, together with the evidence of the unconformities and of the lignites is being examined with a view toward suggesting probable correlations with the deposits worked out at Gay Head by Professor Woodworth (*Bull. Geol. Soc. Amer.*, VIII., 1897, 197–212); although the absence of specific paleontologic evidence renders such correlation merely tentative. The detailed descriptions of the beds and the conclusions inferred with respect to their age will be published in a later paper.

ISAIAH BOWMAN.

CAMBRIDGE, MASS.

EXOGLOSSUM IN THE DELAWARE.

THE occurrence of the little minnow, *Exoglossum maxillingua* (Le Sueur), in the Delaware basin is of interest. So far as I am aware, it has not been taken in any of the tributaries of the Delaware before the capture of two examples which I caught in the Red Clay Creek, Chester County, Pa., during April of 1904. In this instance I am indebted to Mr. Alfred C. Satterthwait, who assisted me in securing the specimens. When first seen, I was under the mistaken impression that they were simply young unmottled examples of *Catostomus commersonnii.*

In the Susquehanna basin this fish is abundant and I have also met with it in tributaries of the Allegheny in Pennsylvania, especially near Cole Grove, in McKean County.

HENRY W. FOWLER.

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA.

SPECIAL ARTICLES.

THE BRAIN OF THE HISTOLOGIST AND PHYSIOLOGIST OTTO C. LOVÉN.

PROFESSOR LOVÉN, the Swedish histologist and physiologist who will be best remembered for his discoveries of the endings of the taste-fibers in the papillæ of the tongue of mammals, as well as of the vaso-dilator nerves, had expressed it as his wish that his brain be preserved after death and studied by his friend and associate, Gustaf Retzius.

With characteristic care and skill Professor Retzius has just published his studies upon Lovén's brain in *Biologische Untersuchungen,* Vol. XII., 1905. The brain exhibits a richness of fissures and these are marked by a superior degree of tortuousness and ramification. The subparietal region is very complex in its surface configuration, while the central (motor) regions are only moderately developed. The cortical centers for speech and language formation are notably large, and Professor Retzius brings this fact into relation with Professor Lovén's notable powers of clear, exact and logical expressions of thought in words; less so in the way of oratorical *finesse* than in the talented use of the best and most adequate expressions. The weight of the brain is not given in this report though its size is said by Retzius to have been well above the average. EDW. ANTHONY SPITZKA.

APPLES INJURED BY SULPHUR FUMIGATION.

RECENTLY some injured Esopus Spitzenburg apples were received at the New York Experiment Station with a request to diagnose the trouble. They were of the first grade, each fruit wrapped in paper, and packed in a bushel box. The financial loss was important, as a considerable amount of high priced fruit had been ruined.

Scattered irregularly over the surface of each apple were conspicuous spots of various sizes where the epidermis was dead, discolored and slightly sunken. Each spot was nearly circular, though on some apples the adjacent spots had coalesced, forming a large affected area of irregular shape. Beneath each spot to a depth of a few millimeters, the flesh was dead, shrunken and dry, appearing as though affected with a dry rot. There was no disagreeable odor or taste to the dead flesh or epidermis.

In the center of each of the smaller spots, and scattered over the larger affected areas, were small bodies resembling the pycnidia of a fungus, but examination showed them to be only the normal lenticels of the apples.

Failure to find either fungi or bacteria as a cause of the injury led to the belief that some treatment of the fruit, such as fumigation, might be a cause. Sulphur, being commonly used for fumigation, was experimented with to note the effects of the fumes upon ripe apples. Fruits of different varieties including Esopus Spitzenburg were placed in a bell jar which was then filled with sulphur fumes. After five minutes the fruit was removed and found to have developed numerous spots that were in every way identical with those on the apples received for examination.

This experiment was repeated many times with wet and with dry fruits, but the characteristic spots were always produced. The spots continued to enlarge for some time after the fruits were removed from the fumes.

The presence of a lenticel in the center of each spot would indicate that the sulphur dioxid passes into the fruit at this point and causes the bleaching of the tissue. A similar effect was produced where an artificial break in the epidermis was made. A lenticel makes a strong color contrast with the bleached epidermis, thus giving it the appearance of a pycnidium.

Sulphur was the only substance used in these experiments; it is possible that other chemicals would produce a similar injury.

Geneva, N. Y. H. J. Eustace.

THE FLOATING LABORATORY OF MARINE BIOLOGY OF TRINITY COLLEGE.

Articles of incorporation have been filed with the secretary of the state of Connecticut 'to establish and maintain a floating laboratory of marine biology for exploration in oceanography and the collection and investigation of the organisms of the sea; to supply colleges, museums and other institutions with material for investigation, study and exhibition.'

A vessel of about ninety tons burden will be secured and equipped with the necessary dredges, trawles, tangles, tow-nets, etc., as well as chemical reagents and glassware for work in marine zoology and botany. When the boat is anchored in a protected harbor immediately it becomes a laboratory. The vessel, in sailing from place to place in the ocean, will furnish most favorable facilities for the investigation of the distribution and variation of organisms. On each expedition it is planned to stay in some particularly desirable locality for about one month so that problems of cytology, embryology and physiology may be undertaken. Competent preparators, artists and photographers will be on the staff so that not only museums and laboratories may be supplied with material, but an effort will be made to meet the specifications of investigators as to fixation and preservation, together with sketches, or photographs, of the organisms desired for their work. In going to a new region each summer large collections for research will be made year after year and it is hoped to greatly extend our knowledge of the local faunæ and floræ of the western Atlantic.

In the early summer of 1906 the vessel will sail to the Bahamas. After a month in the sub-tropics the boat will weigh anchor for the cruise northward, making a harbor every hundred miles or so for the purpose of getting material for comparative studies. In the Bahama Islands the conditions are very favorable for the most abundant and varied organisms since these islands are situated in the mouth of the Gulf Stream where it debouches between Florida and Cuba, bringing with it myriads of creatures caught up in the wide circuit of the current from the equator and through the Gulf of Mexico. The climate, though warm, is agreeable in summer and usually keeps between 84° and 86°. The trade winds blow steadily, the waters are clear and the people honest and simple hearted. Biological investigators have already found the life there in summer both interesting and delightful. These healthful conditions are of great importance for northern men when working hard with both mind and body on the edge of the tropics.

While this project centers in Trinity College, shares have been taken by those interested in other institutions and it is in the largest way for the benefit of all investigators who care to take advantage of the opportunities offered.

Charles L. Edwards.

FEDERICO DELPINO.

By the death, at the age of seventy-two, of Professor Federico Delpino, of the University of Naples, modern botany has lost one of its pioneers. For, according to Friedrich Ludwig, a leading authority on the subject, the foundations of plant biology were laid by the publication in 1867 of Delpino's 'Thoughts on Vegetable Biology, on Taxonomy and on the Taxonomic Value of Biological Characters.'

Born at Chiavari, in the province of Genoa, his childhood was largely passed in the garden of his father's house, where he studied closely the habits of ants, bees and wasps and succeeded in discovering the mode in which the great blue-black bee, *Xylocopa violacea,* constructs its nests. His education was the classical one usually given to an Italian boy of that day, and his employment for nearly ten subsequent years was in the routine of the custom house.

About 1864 a friend called Delpino's attention to the account of an English observer of the manner in which a Ligurian orchid was pollinated by *Xylocopa.* Delpino at once replied to his friend that there should be a similar apparatus in the flowers of the Asclepiadaceæ and he hastened to Chiavari to verify this prophecy. Here he quickly found the *Xylocopa* in the act of pollinating the flowers of a magnificent Brazilian asclepiad.

The discovery of the relation between this plant and its insect visitor was a turning point in Delpino's career, for the paper which he promptly published at once put him into relations with the botanical world and marked the beginning of a long series of brilliant researches. Becoming a professional botanist, Delpino taught successively in the universities of Genoa, of Bologna and of Naples.

His predominant interest was always in the relations between plants and animals, but he made valuable researches and thought profoundly on other departments of botany, attacking problems as far away from his chosen subject as phyllotaxy and plant geography.

As a university professor Delpino was probably more feared than loved by his students. No member of the first class which took the final examination in botany at the University of Naples after Delpino's assumption of the instruction in that department will ever forget the wholesale manner in which the failures were recorded. His manner, too, would impress one who met him for the first time as somewhat ascetic. But an experience of almost ten years, of the unvarying courtesy with which Professor Delpino, in frail health and loaded with researches of his own, would respond to every demand for an opinion leads the writer to remember him as no less typical an Italian gentleman than he was an ideal scholar.

J. Y. Bergen.

Naples,
May 26, 1905.

THE AMERICAN MICROSCOPICAL SOCIETY.

The twenty-seventh annual meeting of the American Microscopical Society will be held at Cedar Point (Sandusky), Ohio, on July 5, 6, 7 and 8, 1905. The society will be the guest of the Ohio Lake Laboratory under the direction of Professor Herbert Osborn of Ohio State University who has placed at the disposal of the meeting all the facilities of the laboratory and who is planning excursions and collecting trips to demonstrate the rich fauna and flora of this region. The meetings will be held in the laboratory with the exception of the president's address which will be given in Sandusky.

The general outline of the program shows that Wednesday morning is devoted to business, the afternoon to the reading of papers and the evening to the address of the retiring president, Dr. Henry B. Ward, on 'The Relations of Animals to Disease.' Thursday's program is especially devoted to medical zoology, the morning being given to papers and the afternoon to a symposium, led by the president, on animal parasites, their effects on the hosts, with demonstrations of specimens and microphotographs, and discussion. This evening the society will be tendered a reception. Friday the program includes papers and a symposium on fresh water biology, led by Dr. R. H. Wolcott, covering the field of limnobiology. The evening will be spent on the beach and Saturday will be devoted to excursions.

Summer tourist rates make Sandusky an easy place to reach from all points, and the new hotel, 'The Breakers,' which has been selected as headquarters, insures satisfactory accommodations. There will be at the meeting demonstrations of apparatus and specimens both by firms and individuals. Persons having specimens or photomicrographs of parasites and other forms which they may wish to show can send them to headquarters in care of the officers and they will be duly presented and returned at the close of the meeting.

COLUMBIA UNIVERSITY AND DR. R. S. WOODWARD.

AT its recent commencement exercises, Columbia University conferred the degree of doctor of science on Dr. R. S. Woodward, formerly professor of mechanics and mathematical physics, and now president of the Carnegie Institution of Washington. He was presented by Professor Edmund B. Wilson, head of the department of zoology and Dr. Woodward's successor as dean of the faculty of pure science, who said: "It is a rare distinction to have attained a position of commanding eminence at once in scientific discovery, in scientific teaching, and in the direction of scientific and educational affairs. It is my privilege to present for the honorary degree of doctor of science one whose many-sided achievement has written his name high on the rolls of fame for all of these—Robert Simpson Woodward, for many years the honored and beloved dean of the faculty of pure science, and now president of the Carnegie Institution of Washington. In a distinguished service of more than twenty years under the national government, as engineer of the lake survey, astronomer and chief geographer of the Geological Survey and assistant on the Coast and Geodetic Survey, his varied and profound researches won for him a secure place in the front rank of those who have successfully grappled with the great problems of astronomy and geophysics. For twelve years a professor at Columbia, his work as teacher and investigator in the fields of mechanics and mathematical physics has offered a model of lofty ideals and exacting standards to his fellow students, whether those whom he taught or those who taught with him. As dean of the faculty of pure science he has served Columbia with a conspicuous devotion, loyalty and success that will not be forgotten. His has been the leadership not alone of the eminent scholar and wise counselor, but of the trusted friend, and his example has taught once again the lesson, greater than any in his own large and difficult field of scholarship, that the cause of learning may be advanced as much by the quality of the man as by the achievement of the man of science. As president of the New York Academy of Sciences, of the American Mathematical Society and of the American Association for the Advancement of Science, he has been the far-seeing and eloquent spokesman of science to his fellows. He has now been called to a place of leadership in organized scientific inquiry for which history can not show a parallel. Columbia bids him godspeed, and gladly pays her tribute of honor to one whose life and work have been an honor to her."

SCIENTIFIC NOTES AND NEWS.

THE American Chemical Society met last week at Buffalo under the presidency of Francis C. Venable, of the University of North Carolina.

THE seventh annual meeting of the Astronomical and Astrophysical Society of America will be held in New York City, December 27–28, 1905.

Dr. William Osler has been made honorary professor of medicine at the Johns Hopkins University. Oxford University has conferred on Dr. Osler the honorary doctorate of medicine.

The University of Michigan has conferred its doctorate of laws on President Henry S. Pritchett, of the Massachusetts Institute of Technology, and the doctorate of science on Professor W. W. Campbell, director of the Lick Observatory.

Dr. Eduard Strasburger, professor of botany at Bonn, has been awarded the gold medal of the Linnean Society of London.

The Society of Arts has awarded its Albert medal to Lord Rayleigh, "in recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses and the development of apparatus for sound signaling at sea."

Dr. Henry H. Donaldson, since 1892 professor of neurology at the University of Chicago, has been elected professor of neurology at the Wistar Institute of Anatomy, Philadelphia, having been selected for this position by the advisory board of the institute, consisting of leading American anatomists. Dr. Donaldson will assume his new duties at the institute on October 1, 1905, and will be at the institute during January, February and March. This arrangement will continue for two years, when Dr. Donaldson will be permanently transferred to the institute. Every effort will be put forth to establish a strong corps of neurological workers, as neurology will be the field to which the institute will devote its first attention. An assistant to Dr. Donaldson will be selected by the advisory board.

The departmental committee appointed by the British Board of Agriculture and Fisheries to inquire into the nature and causes of grouse disease has made the following appointments: C. G. Seligmann, Ph.D., bacteriologist to the Zoological Society of London, as bacteriologist to the commission; A. E. Shipley, M.A., F.R.S., lecturer on advanced morphology of the invertebrata to the University of Cambridge, as expert on the subject of internal parasites; H. Hammond Smith, M.D., as assistant bacteriologist and additional field observer; George Clay Muirhead. B.Sc., as field observer.

Sir Archibald Geikie will give the Huxley lecture at Birmingham in 1906.

Oxford University has conferred the honorary degree of doctor of science on Professor E. Ray Lancaster, director of the Natural History Museum, London.

The University of Wales will confer the degree of doctor of science on Sir John Williams, emeritus professor of midwifery at University College, London, and the degree of doctor of letters on Dr. Henry Jones, professor of moral philosophy at the University of Glasgow.

At the commencement and dedicatory exercises of Washington University, St. Louis, June 15, the degree of doctor of laws was conferred on Professor William G. Raymond, dean of the College of Applied Science, State University of Iowa.

Colgate University has conferred the degree of doctor of laws on Professor A. S. Bickmore, in charge of the department of public instruction of the American Museum of Natural History.

Commander R. E. Peary, U.S.N., expects to sail for the Arctic regions on his new ship *The Roosevelt* on July 4.

M. Jean Charcot has returned to Paris from his explorations in the Antarctic regions. He was expected to lecture before the Société de Geographie on June 16 and before the Royal Geographical Society on June 26.

Professor George Frederick Wright, of Oberlin College, will make a geological expedition to southern Russia, returning in January.

The regents of the University of Wisconsin have granted Professor Wm. H. Hobbs leave of absence for the coming academic year. He will spend some time in study with Professor Ed. Suess at Vienna and with Freiherr Ferdinand von Richthofen in Berlin, in addition to carrying out some geological work in the field.

During the summer of 1905, members of the geologic, topographic and hydrographic corps of the United States Geological Survey will be at work in forty-four states and five territories. Mr. C. W. Hayes will have general supervision of field and office work of the division of geology and paleontology, but the investigations in paleontology and stratigraphy will be specially supervised by Mr. T. W. Stanton, those in petrology by Mr. Whitman Cross, those of metalliferous ore deposits by Mr. S. F. Emmons, those in physiographic and glacial geology by Mr. G. K. Gilbert, those of pre-Cambrian and metamorphic rocks by Mr. C. R. Van Hise. The field and office work of the eastern topographic branch will be supervised by Mr. H. M. Wilson, the work of the western topographic branch by Mr. E. M. Douglas. Topographic mapping will be under field and office inspection of Mr. J. H. Renshawe. The supervision of field and office work of the division of triangulation and computing will be in charge of Mr. S. S. Gannett. Mr. F. H. Newell will have general supervision over the work of the hydrographic branch, but the investigations in hydro-economics will be specially supervised by Mr. M. O. Leighton, those in hydrology in the eastern states by Mr. M. L. Fuller and in the western states by Mr. N. H. Darton. The work of measuring streams will be directed by Mr. N. C. Grover.

Mr. Le Roy Abrams, A.B., A.M. (Stanford), who has held a fellowship in botany in Columbia University during the present year, has been appointed assistant curator in the division of plants of the United States National Museum.

William F. Kirkpatrick has been appointed assistant botanist in the North Carolina College of Agriculture and Mechanic Arts.

Dr. J. Paul Goode, of the University of Chicago, gave an address on 'Forest Conservation,' before the Federation of Women's Clubs of Kentucky, at Cynthiana, on June 9. At the close of the address a State Forestry Association was organized, with Hon. Robert Worth Bingham, of Louisville, president, Mr. W. M. Reid, of Louisville, secretary, and Col. M. H. Crump, of Bowling Green, treasurer.

The annual meeting of the Society of Chemical Industry will open on July 10, at University College, London, when the president, Dr. Wm. H. Nichols, will deliver an address.

The faculty and students of the medical and dental departments of the George Washington University have erected, in the main hall of the department of medicine, a bronze tablet to the memory of their late dean and professor of chemistry and toxicology, Dr. Emil Alexander de Schweinitz.

A monument in honor of Professor Tarnier was unveiled in Paris, on June 1, and handed over to the city by Professor Brouardel. *The British Medical Journal* states that the monument—which is a high relief by the well-known sculptor, Denys-Pusch—represents Tarnier, in the blouse and apron he wore in hospital, standing at the bedside of a mother who holds her infant in her arms, whilst at the head of the bed is indicated an incubator. An elegant portico by the architect Scellier, of Gison, serves as a frame to the marble, and this decorates the rounded end of the Clinique Tarnier, which faces the Boulevard Montparnasse at the junction of the Rue d'Assas and the Avenue de l'Observatoire. Above the sculpture are the words 'Tarnier, 1828–1897,' while below is the inscription, 'To the Master, who devoted his life to the mothers and infants: his colleagues, his pupils, his friends, his admirers.'

The deaths are announced of Dr. Franz Pless, emeritus professor of chemistry at Lemberg, at the age of eighty-six years, and of Dr. A. A. Stückenberg, professor of geology at Kasan.

There will be a New York state civil service examination, on July 19, to fill the position of chief of the Bureau of Statistics and Information of the Department of Agriculture, with a salary of $1,500; and of assistant in photographic chemistry in the Cancer Laboratory at Buffalo, at a salary of $720.

A new pharmacological Institute has been opened at Vienna under the direction of Professor Mayer.

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The Ontario legislature is expected to provide $500,000 for Toronto University, part of which will be used for a university hospital.

Mrs. E. C. Thayer, of Keene, N. H., has given $50,000 to Brown University for general purposes.

Mrs. Thomas F. Ryan has given $50,000 to Georgetown University towards the cost of the new gymnasium.

Dean W. N. Polk, of the Cornell Medical College, has given $15,000 for the establishment of John Metcalf Polk memorial prizes for medical students.

Two traveling scholarships of the value of $1,500 each have been established at the University of Paris for women who intend to become teachers.

The formal dedication of the new physical laboratory at Purdue University took place on May 20. The principal address was by Professor Henry S. Carhart, of the University of Michigan, his subject being 'Some Leaders in Physical Science.'

The School of Applied Science of the State University of Iowa has been reorganized into a college, and the present director of the school, Professor William G. Raymond, has been made dean. A new fireproof building is being erected, and is expected to be in service before the end of this year. Contract has just been let for the building of a dam across the Iowa River below the university grounds. This dam, besides providing a sheet of slack water about two miles long on which the university borders, will provide power for the institution, and for experimental purposes, and will have constructed near one end a canal across which removable dams of various sections will be placed for the study of flow over such structures.

The Rev. Dr. Herbert Walsh Welch has been installed as president of the Ohio Wesleyan University.

Professor E. B. Lovell, of Columbia University, has declined the call to be dean of the College of Civil Engineering of Cornell University, owing to the fact that certain alumni have objected to the appointment.

Professor Charles G. Rockwood has become professor emeritus of mathematics at Princeton University.

Professor George W. Plympton, head of the department of civil engineering in the Polytechnic Institute of Brooklyn, will retire at the end of the academic year.

At the Johns Hopkins University Dr. Florence R. Sabin has been promoted to be associate professor of anatomy. Other appointments in the medical faculty are: Dr. William S. Baer, associate in orthopedic surgery; Dr. Thomas R. Boggs, associate in medicine; Dr. Charles H. Bunting, associate in pathology; Dr. Richard H. Follis, associate in surgery; Dr. William W. Ford, associate in bacteriology; Dr. J. Morris Slemons, associate in obstetrics; Dr. George Walker, associate in surgery; Dr. J. Hall Pleasants, instructor in medicine; Dr. Francis C. Goldsborough, assistant in obstetrics; Dr. Arthur W. Meyer, assistant in anatomy; Dr. Robert Retzer, assistant in anatomy, and Dr. George H. Whipple, assistant in pathology. The two university fellows in pathology and physiology are Drs. Ernest K. Cullen and J. A. E. Eyster.

Mr. Wm. Harper Davis, instructor in philosophy and psychology at Lehigh University, has been elected assistant professor, in charge of the department.

Dr. E. L. Norton, of the University of Wisconsin, has been appointed instructor in philosophy at Adelbert College.

Appointments at Yale University have been made as follows: Seth E. Moody, Howard D. Newton, Carl O. Johns and Paul M. Butterfield, assistants in chemistry; Dr. C. B. Rice, instructor in applied electricity; Luther C. Weeks, assistant in mathematics; Philip H. Mitchell, assistant in physiological chemistry.