SCIENCE NEWS.

VOL. I. MAY 1, 1879. No. 13.

NATIONAL ACADEMY.

The annual meeting of the National Academy of Sciences was held at Washington, April 15 to 18. There was a very full attendance of members, and the different branches of science were well represented. We surrender the greater portion of our columns in the endeavor to give fair space to the papers presented. The abstracts have been carefully prepared so as to serve as a permanent record of the advances made in different lines of research, and they constitute the only report of the scientific proceedings of the meeting. The order in which the papers were delivered is not followed in this report. The meeting was opened by the acting president, Prof. O. C. Marsh, with a review of the academy's official work during the previous year. This is here given in full:

ANNUAL REVIEW.

By Prof. O. C. Marsh.

Gentlemen: The past year has been one of the most eventful in the history of the National Academy of Sciences, and, as the duty devolves upon me of presenting to you a statement of what has been done since our last annual meeting, I have thought the record of sufficient importance to be given in some detail.

In coming together at this time, the thoughts of every member will at once revert to the great loss which the academy has sustained since we last met here, in the death of our honored President, Professor Joseph Henry, who died in this city, May 13th, 1878. Of the loss to science and to the world of one who has done so much to increase the sum of human knowledge, and to promote its diffusion among men, it is not my province here to speak. Others more familiar with the life-work of Professor Henry will do justice to this suggestive theme. It is, however, fitting to this occasion, that I should allude, at least, to Professor Henry's great services to the academy as its presiding officer during the last ten years.

After the death of the first president of the academy, Professor Alexander Dallas Bache, in 1867, Professor Henry was elected his successor at the next meeting, in January, 1868. From that time until he left the chair at the last annual meeting, in April, 1878, it had been his constant thought to advance the best interests of the academy. How zealously he guarded its good name; how impartially and wisely he guided its deliberations; and how earnestly he strove to maintain for it a high standard in science, we can all bear ample testimony.

You have already learned that a short time before the death of Professor Henry, a special mark of esteem was conferred upon him, and through him upon the academy, by a number of gentlemen, who contributed the generous sum of forty thousand dollars ($40,000), to establish the "Joseph Henry Fund." In accordance with the instrument of gift, this sum is to be held in trust, and the income from it paid to Professor Henry's family until the decease of the last survivor, when

the fund will be delivered to the academy. The principal is to remain intact, and the income to be used to promote scientific research. To enable the academy to accept and administer trust funds, will require a special act of Congress, which, it is expected, will be passed during the present session.

The biographical memoir on Professor Henry will be prepared by Professor Simon Newcomb, and presented to the academy at the next annual meeting.

The academy has recently lost by death two other members, Dr. Jared P. Kirtland, who died in Cleveland, Ohio, December 10th, 1877, and Professor William M. Gabb, whose death occurred in Philadelphia, Penn., May 30th, 1878. I have requested Professor Newberry to prepare the biographical notice of Dr. Kirtland; and Dr. Gill, the memoir on Professor Gabb.

In accordance with a decision of the council at the last annual meeting, a scientific session of the academy was held at Columbia College, New York, November 5th to 8th, 1878. The meeting was fully attended, and twenty-two papers were presented.

In June of last year, an act of Congress was passed containing the following clause:

'And the National Academy of Sciences is hereby required at their next meeting to take into consideration the methods and expenses of conducting all surveys of a scientific character under the War or Interior Department, and the surveys of the Land Office, and to report to Congress as soon thereafter as may be practicable a plan for surveying and mapping the territories of the United States on such general system as will, in their judgment, secure the best results at the least possible cost; and also to recommend to Congress a suitable plan for the publication and distribution of reports, maps, and documents, and other results of the said surveys."

As this was the first instance in which the advice of the academy had been asked by direct act of Congress, the action to be taken in response demanded most careful consideration.

When this law was passed, I was in Europe, and had no opportunity to consult with members of the academy until after my return in August. Then, the advice of members of the council and others was secured, and the best means of meeting the requirement of the Government fully discussed.

The act of incorporation, and the constitution of the academy provided specifically what should be done in such a case. I was required to appoint a special committee to consider the subject. The report of the committee, when completed, could, in accordance with the constitution of the academy (Article V., Section 4), be transmitted directly to the Government, and afterward to the academy at its next stated session. Inasmuch, however, as the subject to be considered was of great importance, I thought it better to have the report submitted first to the academy, before transmission to Congress.

In the appointment of this special committee, it was obvious that I could not properly select as members any of those who had taken part in the controversy between the then existing Government surveys; which contention, it was said, had resulted in the passage of the law for the proposed reorganization. Again, the subjects to be considered by the committee pertained to mensuration, geology, and natural history, and I, therefore, selected those who were familiar with these branches of science, namely: Professor James D. Dana, whose long experience as geologist and naturalist of the Wilkes Exploring Expedition, and subsequent residence in Washington, while preparing his reports, had especially fitted him to advise on Government work; Professor William B. Rogers, the Nestor of American geology, who had had long and varied experience with geological and geographical surveys; Professor J. S. Newberry, the State Geologist of Ohio, who had spent several years in the West on government exploring expeditions under the War Department; Professor W. P. Trowbridge, a graduate of West Point, who, while a member of the Corps of Engineers, served for several years on the Coast Survey; Professor Simon Newcomb, whose knowledge of mathematics and astronomy rendered his advice most valuable; and Professor Alexander Agassiz, whose experience both in mining engineering and biology made him a fit representative of those departments.

As the surveys under the War Department and the Interior Department were the special subjects for investigation, I addressed letters to the Secretary of War and the Secretary of the Interior, informing them that a committee of the academy had been appointed to consider the matter; and requested any information as to the scientific surveys under their departments they might think proper to lay before the academy. In reply, the Secretary of War sent a communication from the Acting Chief of Engineers of the Army, and the Secretary of the Interior sent reports from the Commissioner of the General Land Office, from Professor F. V. Hayden, and from Major J. W. Powell, all of which were carefully considered by the committee. From other persons, also, including several officers of the army, and others specially familiar with the government surveys, information was sought, and valuable suggestions received. The committee gave the subject careful and conscientious consideration, and the report received their unanimous approval.

To bring the report before the academy, a special meeting was called, in New York, November 6th, and in the notice issued to members, the clause of the law referring the matter to the academy was quoted in full, so that every member should understand the subject to be considered. The report was submitted to the academy at this meeting, and after a full discussion of three hours was adopted with only a single dissenting vote.

After the adjournment of the meeting, I went to Washington, and informed the officers of the government most interested in the proposed legislation, of the action of the academy; since I thought, as a matter of courtesy alone, they were entitled to early information. The President, the General of the Army, the Secretary of the Interior, the Secretary of the Treasury, and the Superintendent of the Coast Survey, all approved of the plan proposed by the academy. The Secretary of War, I failed to see, as he was indisposed while I was in the city. The Chief of Engineers did not approve of the proposed plan.

When the session of Congress began, in December last, I transmitted, in accordance with law, an official copy of the report to the President of the Senate, and one to the Speaker of the House of Representatives. As the law asking the advice of the academy originated in the House, I sent to the Speaker, with the report, the special communications relating to the government surveys received from the Secretary of War and the Secretary of the Interior. The report of the academy was duly received by the Senate, and ordered to be printed. (45th Cong., 3d Session, Mis. Doc. No. 9.) The copy sent to the House of Representatives was likewise received, and printed with the accompanying documents. (45th Cong., 3d Session, Mis. Doc. No. 5.)

On the transmission of the report to Congress, the official action of the academy in this matter was, of course, at an end, as the duty required had been performed. As a matter of history, however, I may add that the

Committee on Appropriations in the House, to whom the report was referred, embodied the entire plan of the academy in a bill (H. R., 6140), which was duly reported to Congress. The portion of the academy's plan relating to geological surveys, and the appointment of a commission on the public lands became a law. (Sundry Civil Bill, approved March 3d, 1879.) A member of the academy, Mr. Clarence King, has since been appointed by the President Director of the new Geological Survey of the United States, and has entered upon his duties.

In answering the direct requirement of Congress, in a matter of such great importance, it was clearly the duty of the academy, as well as its own interest, to consider the subject without regard to persons or to parties; and to propose a plan which seemed to promise the best results, not merely for to-day, but for the future as well. Whether the plan proposed by the academy to Congress was the wisest and best that could have been devised, under all the circumstances, may be left for the the impartial historian of the future to decide.

At the meeting of the academy in April last, a resolution was adopted authorizing the appointment of a committee to consider a plan proposed by Professor Newcomb, for determining the distance of the sun by measuring the velocity of light. In accordance with this vote, I appointed as members of the committee, President F. A. P. Barnard, Professors Wolcott Gibbs, Henry Morton, George F. Barker, and E. C. Pickering. Their report was so favorable to the plan proposed, that I sent it to the Secretary of the Navy for transmission to Congress.

An appropriation of five thousand ($5,000) for the required purpose was thus secured, and the work of constructing the necessary apparatus will be commenced as soon as the appropriation is available. The expenditure of the funds is entrusted to the Secretary of the Navy. It is hoped by those who proposed this plan that the experiments will lead to a more accurate determination of the distance of the sun than can be obtained by any other method known to astronomy.

In the act of Congress establishing a National Board of Health, which became a law in March last, the academy is requested and directed to co-operate with this board, and report to Congress at the next session. A communication has been received from the president of the board, enclosing a certified copy of the act, and requesting the academy to appoint an agency with which the board will confer to carry out the provisions of the law. I have informed the president of the board, that the academy would co-operate heartily in the proposed work, but no other definite action has as yet been taken.

In concluding this brief but eventful record of the past year, I must congratulate the academy upon the work accomplished, and especially upon the cordial relations now existing between it and the various branches of the Government.

SPECTROSCOPIC STUDIES.

By Charles S. Peirce.

Two papers were presented by Mr. Peirce, entitled respectively, "On Ghosts in Diffraction Spectra" and "Comparison of Wave Lengths with the Metre." It is well known to users of diffraction spectroscopes that ghosts of the lines appear in the images. For instance, on each side of the well-known sodium line, a ghost of it is seen. These attendants only appear in spectra produced by diffraction, and are not found in the spectrum from a prism. They are due to periodic inequality in the ruled lines of the glass. If we suppose that the screw which makes the ruling is somewhat eccentric, we shall find that this eccentricity—so to speak—

winds down around the screw. But every diffraction plate which Mr. Peirce examined was found to have a different eccentricity. In the higher orders of spectra, the first ghost of each line becomes relatively brighter. Mr. Peirce has investigated this subject from a mathematical point of view, and he presented to the Academy a series of calculations based on the conditions which call forth these ghosts, and concluding with formulæ for determining their positions.

In conjunction with Mr. Rutherfurd, Mr. Peirce has been investigating the relation of the wave-lengths of light to the metre. The object is to obtain a basis for measuring the standard metre. The metres that have been issued as standards change in length after a lapse of time. The German metre is said to differ from the French metre by one 25,000th. Mr. Peirce proceeded on the assumption that the wave-lengths of light are of a constant value. We cannot say, however, that on that point we are perfectly certain; there may be a variation in wave-lengths if the ether of space, through which the solar system is travelling, has different degrees of density. But as yet we are not informed of such variation.

The idea of using wave-lengths as a standard of comparison is not new. Arago has suggested it. St. Clair Deville and Mascart made a step in that direction in the measurement of the distances between a flat and a lenticular surface when the Newtonian rings are produced. But the task which was undertaken by Messrs. Peirce and Rutherfurd is more difficult. Indeed, it seems at first sight foolhardy to attempt to attain the measure of a wave-length within 1,000,000th of itself; to be accurate within 1,000th of the distance between the D lines that were formerly considered difficult of separation. The definition now obtained is very much better than was expected; the lines themselves are much finer.

Certain questions have arisen in the course of this research. It was necessary to ascertain whether the spectral lines were fine enough to serve the purpose. There was a doubt as to whether the lines were displaced by "ghosts," and this led to the mathematical inquiry, previously alluded to, which has defined the position of ghosts relatively to the lines. Again, it was found needful that the spectrum to be observed should be at its maximum of brilliance. It had been noticed that two spectra composing a pair—(that is, of the same order)—are usually of different brightness, the right side spectrum differing from the left side one. This was specially true of spectra obtained from ruled glass; those from speculum metal were not so notably diverse in brightness. Examination showed that this characteristic was due to a difference in the sides of the groove ruled in glass. The diamond, in ploughing through the surface, raises a bur on the side of the furrow, and, hence, makes the two sides of the cut of unequal height. At first it was attempted to remove this imperfection by rubbing off the bur; but it was found that the material of the bur went to fill up the groove, and thus rendered the glass plate unserviceable. But, by first filling the groove with black-lead, then polishing off the bur, and finally removing the black-lead, plates were obtained that gave spectra of the utmost brilliancy, and the right and left spectra of each pair did not differ in brightness from each other.

Mr. Peirce also gave the particulars of other improvements recently made in spectroscopic apparatus. One of these involved the construction of glass circles, and the work was so delicate that a well-known instrument maker had failed in four attempts. A method was described by which the accurate focussing of the heliostat—a matter of great importance—had been satisfactorily attained.

In the experiments for ascertaining the relation of a wave-length to the metre, use was made of a line between D and E; the first prominent line after D. The probability of error with the instrument, as first constructed, was one 200,000th of a wave-length; but better results are anticipated from improved methods. Lines on polished metal serve excellently for the measurements; you can see down to the bottom of each line. The comparator used had heavy ways of cast iron, cemented down with plaster of Paris to a block of marble. Carriages run on the ways, bearing microscopes and scales. The details of the apparatus cannot be properly explained without diagrams. Minute precautions are taken to prevent distortion. The experimenters have succeeded in measuring a number of decimetre scales by centimetres. The probability of a single error is within the fiftieth part of a micron. (A micron is as much smaller than a millemetre as the latter is less than a metre.) Means have been devised which keep the apartment, where the experiments are made, at a fixed temperature, within one-tenth of a degree of Fahrenheit. With a sufficient number of observations, and the use of apparatus having their latest improvements, these experimenters hope to attain the object of their research, and limit the error to one-millionth part of a wave-length.

ECLIPSES OF JUPITER'S SATELLITES.

By Prof. E. C. Pickering.

As compared with other methods of obtaining the distance of the sun, the calculation from the eclipses of Jupiter's satellites has the advantage of directness and simplicity. Given an exact knowledge of the speed of light, and accurate observations on the eclipses of the Jovian system, and the distance of the sun could be determined with equal exactness. But there are certain difficulties in the way of accurate observation of these eclipses; it is not easy to fix the exact moment of the disappearance or reappearance of the satellite. The eclipse is not an instantaneous phenomenon, such as we might conceive of if both satellite and primary were mere points in space, instead of large masses of matter. The eclipse of a satellite begins with its entrance into the penumbra, in which the primary cuts off part of the light of the sun, and hence the amount of light reflected by the satellite is diminished. It is also true that at first only a part of the satellite enters the eclipse. To our eyes, the appearance is, simply, that the satellite grows more and more faint, and at last is lost to view. But we cease to see it because of its faintness, before its actual disappearance by total eclipse has taken place. We cannot assign an exact numerical relation to the difference of time between the observation of disappearance and the moment of total eclipse, because the disappearance is connected with adventitious circumstances, such as the condition of the atmosphere, the altitude of the planet, the definition and power of the telescope, the training and capacity of the eye of the observer. It may be mentioned that a screen, to cut off the light of the planet, is found useful in securing a view of the satellite when the light from the latter is much diminished.

Professor Pickering has adopted the photometric method for making these observations. This method should give us the proportion of light furnished by the satellite during the times when it is in process of disappearance and of reappearance. Another satellite is selected for the purpose of comparison with the satellite that is to be eclipsed. A double image is obtained by means of a Nicol's prism, and the light of the satellite that is to be eclipsed is taken in terms of the light from the other satellite. In making the comparisons, the prism is turned so as to show what amount