unite to a reservoir which opens to the sea water by a pore. The pores are quite regularly arranged over the outer surface of the organ from which the light emerges.

Despite the general appearance of an organ of external secretion, no luminous material is excreted to the sea water by the living fish. This rather unusual fact has, I believe, its meaning. If the organ is tested in sea water and examined under the microscope, innumerable motile rod-shaped bacteria, sometimes forming spirilla-like chains, can be seen. Smears of the organ, which I obtained in Banda, have been very kindly stained for me by Professor Dahlgren, of Princeton University, and show the bacteria nicely.

In chemical respects an emulsion of the organ behaves just as an emulsion of luminous bacteria and differs in one or another way from extracts of other luminous animals. These various characteristics may be summarized as follows:

1. The light organ is extraordinarily well supplied with blood vessels and the emulsion fully as sensitive to lack of oxygen as are luminous bacteria. Light ceases very quickly in absence of oxygen.

2. If dried, the organ will give only a faint light when again moistened with water. This is characteristic of luminous bacteria. The luminous organs of most other forms can be dried without much loss of photogenic power.

3. Luciferin and luciferase can not be demonstrated.

4. The light is extinguished *without a preliminary flash* by fresh water and other cytolytic (bacteriolytic) agents.

5. Sodium fluoride of 1 to 0.5 per cent. concentration extinguishes readily the light of an emulsion of the gland.

6. Potassium cyanide has an inhibitive effect on light production in about the same concentration as with luminous bacteria.

To these observations must be added the very suggestive fact that the light of *Photoplepharon* and *Anomalops* continues night and day without ceasing and quite independently of stimulation. This is a characteristic of luminous bacteria and fungi alone among organisms, and very strongly suggests that the light is actually due to symbiotic luminous bacteria. The organ becomes, then, an incubator for the growth and nourishment of these forms and we may perhaps look upon the pores mentioned above as a means of exit for dead bacteria. Otherwise their existance would be inexplicable in an organ which certainly does not produce an external secretion.

Actual proof that the bacteria found in the organ are luminous can only come when these are grown artificially. My attempts in this direction have failed. Good growths of bacteria were obtained on pepton-agar but they produced no light. One might expect that a symbiotic form would require rather definite food materials to produce light and it is, perhaps, not surprising that culture experiments have failed. We have Giard and Billet's experience with the form infecting sand fleas. This could be grown artificially but only produced light when infecting the sand fleas themselves. Certainly, the ocular and chemical evidence, if not the cultural evidence, supports the view that the light of these living fish is bacterial in origin. A complete account of the fish will appear shortly in the Carnegie Institution Publications.

E. NEWTON HARVEY
PRINCETON UNIVERSITY,
March 1, 1921

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION L—HISTORY OF SCIENCE SESSIONS

THE growing and widespread interest in the history of science, in this country, was very evident during the Convocation Week (December 27–January 1), when two learned national organizations held meetings in Washington, D. C., and Chicago. Each of these organizations held sessions upon the history of science.

During the same week in 1919, The American Historical Association inaugurated the movement by holding at its Cleveland meeting, a most interesting and successful conference.[1] This same asso-

[1] SCIENCE, N. S., Vol. LI., pp. 193–194, February 20, 1920.

ciation again held a conference in the History of Science at its Washington meeting.[2]

This year (1920) a similar movement was instituted by the scientists, and the president of the American Association for the Advancement of Science, through the council, appointed an organizing committee consisting of the following scholars:

Dr. William W. Welch, Johns Hopkins University,
Dr. A. P. Carman, University of Illinois,
Dr. Felix Neumann, Washington, D. C.
Dr. George Sarton, Carnegie Institution,
Dr. William A. Locy, temporary chairman, Northwestern University,
Dr. Henry G. Gale, University of Chicago,
Dr. C. Judson Herrick, University of Chicago,
Frederick E. Brasch, secretary, John Crerar Library, Chicago.

Through the efforts of this committee the policy of the History of Science section was established. The principal fact to be noted, however, in conjunction with this policy, was the adoption of a plan whereby the function of the program committee was such as to offer the utmost freedom in cooperating and coordinating with existing sections in the American Association. In view of the unique position of the History of Science section relative to the older sections, the relation is such that conflicts of interest are great. Therefore, in order to advance the work and interest of the History of Science, and, at the same time, minimize this conflict—also to meet the growing interest of a large number of scholars both in the technic and history of their respective sciences, the following policy has been approved:

The program shall be flexible, so that such papers as are technical (example—mathematics) in historical treatment be given in sections where they will be most appreciated, and the more general historical papers be given in the special section (History of Science). It is also the opinion of the committee, that papers for this section shall be given by invitation.

This plan was thought most feasible, and has subsequently proven a success, as was evident at the first conference during American Association for the Advancement of Science week.

Consequently, the first joint session was held with Section A (American Mathematical Society and the Mathematical Association of America). Papers were presented by well known scholars in the History of Mathematics. The first was by Dr. Louis C. Karpinski, of the University of Michigan, who presented a most interesting topic, namely: "Geometrical development of analytical ideas."

The purpose of this paper is to show that many of the fundamental concepts of analysis had their progenitors in ideas developed by the Orientals, the Greeks, the Arabs, and the Europeans, to the time of Newton, along geometrical lines. The algebraical problems of the first degree equation in one unknown, the quadratic and the cubic, were all early solved by geometrical means; many of the dominating "motif" problems and theories of geometry lead directly to the quadratic and the cubic. The problem of the pentagon, of the trisection of the angle, of the duplication of the cube, of the conic sections of the regular polygons of seven and nine sides, and even of the squaring of the circle, all contributed to the geometrical development of analytical ideas.

With the Arabs first came the quite complete appreciation of the algebraical and geometrical correspondences, which culminated, of course, in the work of Descartes, with whom modern mathematics begins.

The second paper was given by Dr. David Eugene Smith, of Columbia University—"The earliest mathematical work printed in the New World."[3]

It was supposedly known that the earliest mathematical work printed in America was that by Isaac Greenwood, first Hollis professor of mathematics and natural philosophy at Harvard College (1727–1738). It was printed in Boston, 1729. However, it thus appears through Dr. Smith's efforts that the first mathematical book printed in America was one printed in Mexico City, 1556. Of this work, known as the "Sumario Compendiso," there remain perhaps only four copies. The book consists of one hundred and three folios, generally numbered. The author, Juan Diez, undertook the work primarily for the purpose of assisting those who were engaged in buying of gold and silver from Mexico, for the moneyed class of Spain. The principal text consists of tables relating to the purchase price of various grades of silver, and of gold, and to monetary affairs of various kinds. The mathematical text consists of twenty-four pages of problems of arithmetic and algebra. Aside from the great historical importance and rarity this book possesses, it also has an interesting place in the early history of education in America.

In the second joint meeting the third paper was presented by Dr. Florian Cajori, of the University of California. His topic, "The evolution of algebraic notations," was illustrated by slides. Due to the extremely technical character of this topic, which involved so many symbols and signs, and the tracing of the evolutionary character of the notation by a long and painstaking detail study, it is not possible to give an adequate ab-

[2] Science, N. S., Vol. LIII., p. 122, February 4, 1921.

[3] A full account of this paper is to be found in *The American Mathematical Monthly*, 28: 10–15, January, 1921.

stract here. However, Dr. Cajori pointed out that there was danger in having both too few symbols for notations, and also too many. While mathematics is essentially a science of logic by symbols, yet there is a justification for conservative use of such notations.

The most notable fact observed at these joint meetings was the keen interest shown for historical papers, which may be an innovation to the mathematicians and a matter to be considered for future meetings. It only proves too conclusively the value and importance historical papers have within the technical group. Not alone has the cultural phase been emphasized, but there is also the psychological phase. The arduous task of listening to a long series of extremely technical papers is enlivened by a reaction given by some historian's account of a period, a biography or event in mathematical progress.

Wednesday afternoon at 2 o'clock the first single session of the History of Science section took place. After a few brief introductory remarks, concerning the purpose of the History of Science section and a report of the organizing committee, Dr. William A. Locy, temporary chairman, introduced the first speaker, Dr. James H. Breasted, of the Haskels Oriental Museum, University of Chicago, who spoke at length upon "The state of research in early Egyptian science." Dr. Breasted's research has enabled him to point out the large possibilities for greater investigation in the practical unknown Egyptian sciences. His remarks gave one to understand that the future historian of science will have to labor long and hard in the fields from astronomy to medicine and engineering. The question is, where to find the student prepared for this practically unexplored field.

Dr. Walter Libby, professor of the history of medicine, University of Pittsburgh, spoke upon "John Hunter as a forerunner of Darwin." Too little seems to be known of John Hunter (1728–1793) from the point of view of a biologist. A man self-educated late in life, he rapidly rose to a position in the medical sciences, and became an authority in research into anatomical and physiological problems.

The next paper was "Sir William Osler's last historical discovery," by Mr. J. Christian Bay, medical librarian, John Crerar Library. Osler's last literary investigation was probably one of the most interesting and fascinating pieces of historical discovery of recent date in the History of Science. The place and labors of the mystic philosopher, Nicholas of Cusa (1401–1464) is not very well understood in the history of scientific thought. Mr. Bay presented phases of Osler's discovery that were practically unknown; that Cusa possessed some understanding of static electricity, that he performed experiments, and in general was far in advance in ideas bearing upon magnetism. It would thus appear that Cusa preceded William Gilbert (1540–1603) by about 150 years. At the close Mr. Bay paid a beautiful tribute to Sir William Osler, as a man, scholar and scientist.

Owing to the interesting and long discussions provoked by the preceding speakers, the time was growing short, therefore, Dr. Locy's paper was given by title only—"The earliest printed book on natural history—1475–1500."

Dr. Frank B. Dains, of the University of Kansas, presented a paper entitled "Applied chemistry in prehistoric and classical times." The work of the early people in the use of bronze, iron and other metal, showed to some extent the possibility of metallurgy being understood. Applied chemistry of the prehistoric people and in classical times is so little known that the problems of research in the history of science offer immense results. We have very little in the form of written records, but buried treasures as they are brought up by the excavations of archeologists are probably better than the records themselves. Dr. Dains pointed out, as did Dr. Breasted, that the whole history of science before Greek civilization is yet too far in the realm of the unknown.

The last paper of this group was "Early surveying and astronomical instruments in America," given by Dr. Florian Cajori, who, with the aid of illustrated views, showed a remarkably interesting collection of instruments imported, and also constructed in this country. The most complete and well constructed coast and geodetic survey instruments made for the early survey in the United States were those of Ferdinand R. Hassler. A Swiss surveyor of excellent training gave to this country his best talent and consequently laid a foundation for future work that has not been revised or repeated. Dr. Cajori brought out many interesting facts and views in relation to Hassler that were entirely new to the history of science in America.

Thursday morning was devoted to the remaining part of the single session of the History of Science section. The papers presented at this time were of much longer duration. Dr. W. Carl Rufus, of the Detroit Observatory, University of Michigan,

prepared a splendid and also unique outline of the "Proposed periods in the history of astronomy in America." Dr. Rufus showed clearly by six successive steps, or periods, how each developed and expanded into a "two-dimensional form," or system.

Beginning with the introductory period (1490–1600) he stated how astronomy played its part in early navigation and explorations. Following the colonial period (1600–1780) was the beginning of observational astronomy, dominated by John Winthrop and David Rittenhouse. Next was the apparent stationary period (1780–1830), the beginning of mathematical astronomy, established by Nathaniel Bowditch and Benjamin Peirce. Following this came the popular period (1830–1860), the beginning of practical astronomy and the rapid rise of college observatories. New astronomy (1860–1890) was the beginning of astrophysics—the study of the chemical and physical properties of the star light. The last is the contemporary or correlation period (1890–), the beginning of quantitative astrophysics.

In each of these six successive periods of course there is the overlapping in time—there is no clear demarcation setting off one period from another. Such an outline as presented by Dr. Rufus should form the basis of the history of the physical sciences in America. This paper is to appear in print in the course of a few months.

The last paper before the History of Science section was that by Dr. H. A. Bumstead, of the National Research Council and of Yale University. Dr. Bumstead presented the paper "The history of physics," which was one of a series of lectures on the History of Science given before the Yale faculty and students.

The history of experimental physics from the time of Newton to the present was given so ably and charmingly that one might almost say a standard of scholarly presentation of a scientific topic had been reached. Fortunately this paper also is to appear in one of the early numbers of the *Scientific Monthly*, and later to appear in book form. This marked the last public address of Dr. Bumstead, for on the followng day, en route to Washington, he died. The richness of Dr. Bumstead's singularly attractive personality, and the depth of his scholarship and culture have left an indelible mark on all those who have ever come in contact with him.

During the Wednesday session the election for officers of the section was held—and the following were accordingly elected:

For Vice-president: Dr. William A. Locy, Northwestern University.

For Sectional Committee: Dr. Florian Cajori, University of California; Dr. George Sarton, Carnegie Institution; Dr. Walter Libby, University of Pittsburgh; Dr. Louis C. Karpinski, University of Michigan.

For Secretary: Frederick E. Brasch, John Crerar Library, Chicago.

This holding of two conferences by two different organizations, marks the beginning of a new phase of scientific learning and scholarship in America.

In Europe much has been accomplished in the advancement of the History of Science studies, especially so in England. Oxford and Cambridge universities and University of London have recognized the cultural value and have established facilities for research work. Also, independent sections for the History of Science have been organized by the "Versammlung Deutscher Naturforscher und Aerzte," and by the "Società Italiana per il Progresso delle Scienze." The activity of the Italian historians of science is evidenced by the new publication—"Archivio di Storia della Scienza," edited by Aldo Micli; besides other historical publications that are appearing. And it is to be desired similar publications be encouraged and supported in this country. Therefore, it is to be hoped that through cooperation and coordination the History of Science movement, thus fostered and encouraged by the American Historical Association and the American Association for the Advancement of Science, can likewise aid in this "New Humanism." Frederick E. Brasch,
Secretary

THE OPTICAL SOCIETY OF AMERICA

The Optical Society of America was organized in 1916. As stated in its constitution, "It is the aim and purpose of this society to increase and diffuse the knowledge of optics, to promote the mutual interests of investigators of optical problems, of designers, manufacturers and users of optical instruments and apparatus of all kinds and to encourage cooperation among them." While the society pays especial attention to "applied" optics and, on this account, covers a field not previously covered, it is not to be regarded as a technological society in contradistinction to a society devoted to "pure" science. The aim of the society is to cover the field of optics, including "pure" optics as well as "optical engineering."