Fourth annual report of the Johns Hopkins University, Baltimore, Maryland, 1879.

FOURTH ANNUAL REPORT

OF THE

Johns Hopkins University,

Baltimore, Maryland,

1879.

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FOURTH ANNUAL REPORT

OF

THE PRESIDENT.

To the Trustees of the
Johns Hopkins University:

GENTLEMEN:

In presenting to you a Fourth Annual Report, it seems well to sum up not only the doings of the last academic year, but also to give the results of our observations and experience during the last three years. It will be necessary to repeat occasionally some statements which have already been publicly made,—but a general review, even including such repetitions, can hardly fail to be of service to those among us who are engaged in instruction and administration,—while it will enable those at a distance, who are interested in this institution, to understand the principles and methods by which our work is governed.

The Trustees of Johns Hopkins, upon the death of the Founder, held their first meeting February

6th, 1874, and soon commenced the study of university organizations, by conferences and correspondence with the Presidents and Professors of American colleges, by personal visits to leading institutions, and by sending a representative to visit some of the most renowned seats of learning in the old world. Their plans were so far matured in the course of two years that they were publicly made known on the twenty-second of February, 1876. In the autumn of that year, the staff of teachers was brought together, and instruction began on the third of October.

The University entered upon its work with these advantages:—a large fund yielding a steady income; freedom from political and denominational control; an open field unoccupied by any endowment like ours; a central position in one of the oldest States and in the neighborhood of the great scientific establishments of Washington; a library for scholars already instituted; and the immediate prospect of a large General Hospital which may be the nucleus of a school of medicine.

The Trustees who were charged by Johns Hopkins with the oversight of this great project, early came to the conclusion that they would not attempt to rival or copy any existing institution, but would rather try to make a positive contribution to American education. They recognized

the fact that the wants of Baltimore and the region near to it were to be first considered; and they have steadily endeavored to develop an establishment which should aid and be aided by the plans and funds of other foundations, so that in time all the educational work of Baltimore may go forward in harmony.

The local institutions with which it seemed especially desirable to coöperate were these:—the Peabody Institute, having an endowment of $1,250,000, maintaining a large and well chosen Library, a system of public lectures, a conservatory of music, and an art museum; the Johns Hopkins Hospital, the buildings of which are in process of construction; the Maryland Institute, which is the proper nucleus for a Technological School; the Maryland Academy of Sciences, which has undertaken to establish a museum of Natural History; the professional schools of Law and Medicine, and also those of Dentistry and Pharmacy; the Historical, Mercantile, Law, and Medical Libraries; the State Normal School; and—if last to be mentioned, first to be thought of—the public schools, of which, so far as boys are concerned, the City College is the head, and the private schools, maintained by individual or associated efforts.

While looking directly at local requirements, the Trustees had no desire to restrict the useful-

ness of the University to the city or the State, but were in hopes that it would attract many scholars from a distance, by the ability of its Faculty, by the wisdom of its methods, and by the fulness of its apparatus; and that by its investigations and publications its influence might extend beyond any provincial limits.

Having these aims, the next question to be considered was the interior organization of the University,—should it follow an American, an English, a French, or a German model; or should it gather from many sources educational methods to be adapted to the wants of this country and brought into harmony with our conditions, political, ecclesiastical and social. There was no hesitation on this point. The new foundation was to base its operations upon the experience of many and diverse institutions—ascertained by inquiries at home and abroad, among the most enlightened teachers and administrators.

It soon became clear that whatever nomenclature may be adopted, and whatever varieties of form may be seen in the higher educational foundations of modern times, there is an important distinction between the work of colleges and universities.

According to acknowledged precedents still rigidly followed in the old world, universities exercise these fourfold functions:—(1) they pro-

vide advanced instruction in the chief departments of literature and science,—and usually, also, in one or more of the so-called learned professions; (2) they bring together books, apparatus, instruments, works of art and collections in natural history; (3) they encourage investigation and the publication of important researches, and (4) they confer degrees.

Collegiate instruction is properly introductory to university teaching; it is elementary, formal and disciplinary. It is largely devoted to the training of the intellectual powers and the formation of habits of attention, acquisition, memory and judgment,—while it stores the mind with the elements of knowledge. A University cannot thrive unless it is based upon a good collegiate system; and it may rightly encourage or establish a college, if needed, as an important department of its activity.

Let us now examine our work in these various aspects:

1. ***Respecting instruction.*** Thus far no provision has been made for instruction in any of the professions,—but attention has been concentrated on those themes which are commonly spoken of as pertaining to THE PHILOSOPHICAL FACULTY OF A UNIVERSITY; and, so far as I can judge, equal regard has been shown for those subjects which are commonly classed as "scientific" and those which

are classed as "literary." There have been resident professors and assistant professors in Mathematics, Physics, Chemistry, Biology, and Comparative Anatomy; in Greek, Latin, and English, as well as in the Teutonic, Romance, Sanskrit, and Semitic languages. History, Political Economy, Logic, Ethics and the History of Philosophy have also been taught. The resident staff has received the coöperation of non-resident professors who have from time to time given courses of lectures supplementary to those which are given throughout the year. In the selection of permanent and temporary teachers the effort has been made to secure the services of such as are acknowledged to be leaders by those who are of authority in the same departments of study. Some have already won renown; others, who are younger, have given indications of unusual promise; most are excellent teachers as well as independent investigators; the appointments have never been made because of local, ecclesiastical, or personal ties; and every one has been encouraged to render the best and highest services of which he was capable. As it is not easy to give in general phrases a just idea of the instructions which have been in progress, a tabular view of subjects, teachers and hours will be printed in the appendix to which those who are interested in such details may readily refer, if they desire to

see how far the expectations which were awakened three years ago have been fulfilled. The only guarantee of efficient work in any university or college is to be found in the character, attainments, and experience of the academic staff. Excellent teachers are sometimes fettered or embarrassed by unfortunate conditions, such as the over-pressure of engagements or the inadequacy of instruments, but here, every chief instructor has been free to follow those plans which seemed to him best adapted to his theme and to his pupils; no one has been burdened by too many or too onerous appointments; and the requisite apparatus, both literary and scientific, has been liberally provided. Lectures, recitations, personal conferences, formal examinations, laboratory practice and field observations have all been employed. Thus far there has been no occasion to offer prizes or to mark the comparative standing of different scholars. The classes have for the most part been small, and it has been easy to adapt the method of teaching to the needs of individuals. Enthusiastic and steady devotion to study, encouraging in a high degree to the teachers, has been characteristic of the classes. Courses of summer reading have been marked out for those who desired them and have been made the subject of subsequent examinations. Associations in which the professors and the more advanced scholars have alike

taken part have been steadily maintained; and in Mathematics, Greek, and History, some of the methods of the German seminaries have been successfully introduced.

Throughout all the departments a spirit of earnest work, of order, and of good will has been manifested, making us in fact, as well as in name, a College,—SOCIETAS MAGISTRORUM ET DISCIPULORUM.

Graduate Students. The reputation of an able staff has attracted a number of advanced students sufficiently large to make it clear (as many counsellors predicted at the beginning of our work), that educated young Americans are ready to accept the opportunities here offered to them. There have been connected with this institution during the last three years, 127 graduate students, 51 of whom have held Fellowships. They came from the following States:

Maine,	1	Mississippi,	1
Vermont,	2	Louisiana,	1
Massachusetts,	10	Ohio,	3
Connecticut,	2	Michigan,	1
New York,	12	Indiana,	2
New Jersey,	7	Illinois,	3
Pennsylvania,	6	Wisconsin,	1
Maryland,	53	Iowa,	3
[Baltimore, 44.]		Missouri,	1
District of Columbia,	2	Kansas,	1
Virginia,	6	California,	2
North Carolina,	2	Russia,	1
South Carolina,	2	Japan,	1
Georgia,	1		

The Institutions from which they had received degrees were 57 in number,—namely:

Amherst College,	6	Marietta College,	1
Bellevue Hospital Medical School, (N.Y.,)	2	Maryland Agricultural College,	1
Bonn, University of,	1	Maryland, University of,	23
Bowdoin College,	2	Mass. Inst. of Technology,	2
Brown University,	1	Mercer University,	1
California, University of,	2	Michigan, University of,	3
Charleston College, (S. C.,)	1	Muhlenberg College,	1
Cincinnati, University of,	1	Pennsylvania, University of,	2
Columbia College,	2	Physicians and Surgeons, College of, (Balt.,)	1
Columbian University,	1	Princeton College,	5
Concordia College,	2	Pritchett Institute, (Mo.,)	1
Cornell University,	6	Randolph-Macon College,	1
Dartmouth College,	1	Rensselaer Polytechnic Institute,	1
Davidson College,	2	Rochester, University of,	1
Dickinson College,	1	Rutgers College,	2
Dickison Seminary,	1	South Carolina, University of,	1
Drew Theological Seminary,	1	St. John's College,	2
Furman University, (S. C,)	1	Stevens Inst. of Technology,	2
Georgetown College, (D. C.,)	2	Syracuse University,	1
Göttingen, University of,	5	Tokio, University of, (Japan,)	1
Hampden-Sidney College,	1	Virginia, University of,	9
Harvard University,	6	Washington College, (Md.)	1
Haverford College,	3	Washington University, (Balt.,)	2
Heidelberg, University of,	1	Washington and Lee University,	2
Iowa Agricultural College,	1	Wesleyan University,	3
Iowa College,	1	Western Maryland College,	2
Lafayette College,	3	Williams College,	4
Lehigh University,	1	Yale College,	8
Leipsic, University of,	3		

Fellows. Among the graduates the corps of Fellows holds an important place. They are selected by the Faculty and appointed by the Trustees, and are the recipients of an honorary stipend sufficiently large to pay their necessary expenses,—so that they may devote their time exclusively to study. They constitute in fact,

though not in name, a class of young men in training for professorships,—a teacher's class of the highest grade. The importance of this feature in our organization is so great as to call for special consideration here.

The system of Fellowships was instituted for the purpose of affording to young men of talent from any place, an opportunity to continue their studies in the Johns Hopkins University, while looking forward to positions as professors, teachers, and investigators, or to other literary and scientific vocations. The appointments have not been made as rewards for good work already done, but as aids and incentives to good work in the future; in other words, the Fellowships are not so much honors and prizes bestowed for past achievements, as helps to further progress, and stepping-stones to honorable intellectual careers. They have not been offered to those who are definitely looking forward to the practice of either of the three learned professions,—(though such persons have not been formally excluded from the competition,) but have been bestowed almost exclusively on young men desirous of becoming teachers of science and literature, or determined to devote their lives to special branches of learning which lie outside of the ordinary studies of the lawyer, the physician, and the minister.

Every candidate is expected to submit his college diploma or other certificate of proficiency from the institution where he has been taught, with recommendations from those who are qualified to speak of his character and knowledge. But this is only introductory. He must also submit, orally or in writing, such evidence of his past success in study, and of his plans for the future, together with such examples of his literary or scientific work, as will enable the Faculty to judge of his fitness for the post. The examination is indeed in a certain sense competitive; but not with uniform tests, nor by formal questions and answers submitted to the candidates. First the head of a given department considers, with such counsel as he may command, the applicant's record. The professors as a body then deliberate on the nominations made by individual members of their body. The list upon which they agree, with the reasons for it, is finally submitted by the President of the University to the Executive Committee, and by them to the Trustees for final registration and appointment. By all these precautions, the very highest results which could be anticipated have been secured. A company of most promising students has been brought together, and their ability as teachers and scholars has been recognized by the calls they have received to permanent and attractive posts in different parts of the country.

The number of individuals who had been appointed to Fellowships prior to September 1, 1879, was 51; of these 13 began their career in this University as Graduate Students.

The departments of Study of those appointed, were as follows: Mathematics, 6; Physics, 6; Chemistry, 8; Biology, 10; Greek, 8; Comparative Philology, 3; History and Political Science, 3; Philosophy, including Aesthetics, 4; Engineering, 2; Mineralogy, 1.

The present incumbents of Fellowships are 20 in number. Of the 31 others appointed, 16 are now Instructors in Colleges and Universities, (8 here, and 8 elsewhere); 2 are engaged as Teachers in Classical Schools; 2 are attached to the United States Coast Survey, and one to the United States Fish Commission; one is attached to the Metropolitan Museum of Art, in New York City; 4 others are engaged in the practice of professions, other than teaching, (1 Chemist; 1 Civil Engineer; 1 Physician; 1 Lawyer); 4 are still pursuing their studies here or abroad; and one died without entering upon his Fellowship.

The Institutions at which those appointed as Fellows had graduated or received the Baccalaureate degree, were:

Amherst College,	4	Columbian University,	1
Bowdoin College,	2	Concordia College,	2
California, University of,	1	Cornell University,	4
Columbia College,	1	Furman University, (S. C.,)	1

Harvard University,	3	Rensselaer Polytechnic Inst.,	1
Haverford College,	1	Rutgers College,	1
Iowa College,	1	South Carolina, University of,	1
Lafayette College,	2	Stevens Inst. of Technology,	2
Marietta College,	1	Tokio, University of, (Japan,)	1
Mass. Inst. of Technology,	1	Virginia, University of,	5
Michigan, University of,	1	Wesleyan University,	1
Princeton College,	3	Williams College,	2
Randolph-Macon College,	1	Yale College,	6

The Institutions from which the degree of Doctor or Master had been received by the holders of Fellowships were:

Amherst College,	2	Lafayette College,	1
Columbia College,	1	Leipsic, University of,	2
Davidson College,	1	Marietta College,	1
Göttingen, University of,	4	Michigan, University of,	1
Harvard University,	2	Pennsylvania, University of,	1
Heidelberg, University of,	1	Virginia, University of,	1
Iowa College,	1	Yale College,	2

Collegiate Students. In addition to graduates, collegiate students have been received. The number of such who have been enrolled here during the past three years is 91—and almost all of them have come from Baltimore and its vicinity. In order to become "matriculates," or members in full of the university, a rigid examination in Latin, Greek and Mathematics must be passed,—except that scientific students may offer French and German instead of Greek. A good English education with some knowledge of natural science is also expected. Students who are not ready to matriculate in all branches, have been conditionally

received as "candidates" for matriculation, with the understanding that they should quickly comply with all requisitions; and a few who do not propose to become candidates for degrees, have in exceptional cases been admitted as "special students." The policy has been at the outset to invite scholars,—but at the same time to uphold the standard of the best preparatory schools. This is accomplished by prescribing and maintaining a matriculation grade, which is certainly quite as high as American colleges can now insist upon.

After matriculation, the student may follow any one of seven courses which are antecedent to the Baccalaureate degree. These courses are all of them so arranged as to secure a liberal and not a special education; they are supposed to be equally difficult and equally honorable; in them all strict examinations are held, and promotion is only secured by a full compliance with the University requirements. One of these courses provides a thorough classical training; another is chiefly mathematical; a third is based on chemistry and physics; in a fourth, biological sciences predominate; in a fifth, philosophical studies have full recognition; historical and political subjects make the principal themes in the sixth; and in the seventh, modern languages and literature take the place of Latin and Greek. Besides the dominant

or major subjects, minor topics receive attention. By this combination a young man may secure a broad foundation for subsequent work without anticipating his proper professional studies,—and he may, if he chooses, select that course which will tend toward his chosen calling; for example, the biological course is arranged as an introduction to the school of medicine; the course in historical and political science, to the school of law; a different plan of study may lead to the school of theology; and the other courses allow an election between ancient and modern languages, and between the mathematical, physical and chemical sciences.

2. ***Collections of literary and scientific apparatus.*** The Hopkins foundation was preceded by that of the Peabody Institute, already referred to, which has collected an excellent library of over 67,000 volumes, (besides 10,000 pamphlets,) and is constantly increasing. Within the past year, the work of enlarging the Peabody building has been finished, and the accommodations for reading and study have been much improved. It is more and more resorted to by the professors and the scholars of our University, who are in the position to appreciate heartily all that is done by the Provost, the Librarian and the Trustees to make the library a convenient and attractive place for investigation and research. Within its walls some of our com-

pany have spent a large part of their time during the past year.

It would seem as if Mr. Peabody, or his advisers foresaw the day when a company of scholars would be gathered around his foundation. His letter of February 12, 1857, provides—

"For an extensive Library, to be well furnished in every department of knowledge, and of the most approved literature, which is to be maintained for the free use of all persons who may desire to consult it, and be supplied with every proper convenience for daily reference and study, within appointed hours of the week-days of every year. It should consist of the best works on every subject embraced within the scope of its plan and as completely adapted, as the means at your command may allow, *to satisfy the researches of students who may be engaged in the pursuit of knowledge not ordinarily attainable in the private libraries of the country.* It should be guarded and preserved from abuse, and rendered efficient for the purposes I contemplate in its establishment, by such regulations as the judgment and experience of the Trustees may adopt or approve. I recommend, in reference to such regulations, that it shall not be constructed upon the plan of a circulating library; and that the books shall not be allowed to be taken out of the building, except in very special cases, and in accordance with rules adapted to them as exceptional privileges."

In the spirit of this foundation, the Trustees of the Peabody and Hopkins gifts early exchanged letters of coöperation in respect to "all that could advance the cause of education, refinement and culture in our city and State." The Provost of the Peabody, Dr. N. H. Morison, referring, in 1876, to the purchase of Crelle's *Journal für Mathematik*, and other books suggested by Prof. Newcomb, which were likely to be "of great advantage to the students and professors of the higher mathematics about to assemble in Baltimore," proceeded in

these cordial words to speak of the policy of the Peabody library:

"It is proper to say that our library will be tested as never before by the body of learned men, and of students under their direction, which will be called to this city by the establishment of the Johns Hopkins University. I feel that we ought to meet their wants in the purchase of books, so far as it can be done without injury to a library which is not a technical one, but which was founded for the use of the general public. In their researches, every facility should be granted to them which is consistent with the security of the books, and their proper order and arrangement."

Without this aid from the Peabody foundation, our organization would have been very much delayed, and indeed our funds would have been seriously curtailed; for,—while there is no agency, except the living teacher, so important to a University as a large collection of books, freely accessible to those who know how to use them,—a good library is costly to purchase and costly to maintain, and is moreover of slow growth. We have, therefore, reason to be constantly grateful that the Peabody foundation so long preceded the Hopkins.

Those of our staff who are engaged in historical studies are also under great obligations to the Maryland Historical Society and its Librarian, Mr. J. W. M. Lee, who has freely opened the rich historical stores of that society to our use. The rooms of the Society have been for three years granted to us for a Historical Seminary, the members of which have greatly profited by the free access they have enjoyed to the printed sources of American history.

It is indispensable that the professors of a university who are engaged in investigation and publication, should be able to bring to their ordinary studies and laboratories certain books which are commonly bought by public libraries rather than by individuals; such for example as the publications of learned societies, the scientific works issued by governmental aid, collections of inscriptions and texts, zoölogical and other scientific plates, and books privately printed or issued in small editions. In many cases it is not enough to be allowed to consult these books in a public room;—they are of use only when studied with other appropriate aids. Such books are usually procured at a very large outlay, are of interest to but few persons, are rarely called for, and consequently remain on the library shelves untouched from one year's end to the other. There is a growing disposition among librarians to facilitate the use of such books under regulations which will prevent injury and loss. In Germany it is so common a usage as to be almost a rule, that the professors of any university may draw books from the library of any other.

So, in this country, the generous mode in which most of the large libraries are conducted, enables scholars to draw from time to time upon distant collections. It is generally acknowledged by librarians of the school of Justin Winsor, that books are most useful when they are best used; and that

libraries are not so much store-houses, to meet remote contingencies of future wants, as laboratories furnished with the best instruments now required for study. Among the distant libraries to which some of our teachers have been indebted for the loan of books, under special circumstances, are these:

The Smithsonian Institution.
The Library of Congress.
The Library of the Army Medical Museum.
The Library of the Massachusetts Historical Society.
The Royal Library of Munich.
The Library of Harvard College.
The Museum of Comparative Anatomy, Cambridge.

It is under these circumstances that our own library becomes the place for frequent consultation and for daily work. It has four departments—

(*a*) a general reference collection of books, including not only cyclopædias and dictionaries, but copies of the works of great authors, ancient and modern, in different branches of literature and science:

(*b*) several special collections of books which have been bought as the working apparatus of those departments of study now instituted among us, from lists which have been furnished by the several instructors:

(*c*) a transient collection of *new* books, English, French and German, brought here for examination as soon as published, sometimes by

purchase, and sometimes by the courtesy of dealers:

(*d*) a very full collection of current periodical literature, so selected as to supplement the lists of the Peabody, the Mercantile Library, and other reading rooms of Baltimore. A printed list of these journals, published in December, 1878, includes 579 periodicals, 251 of which are taken by the University.

Our reading room is open from 9 a. m. to 10 p. m., and is quiet and attractive. The authorities have acted in the spirit of Panizzi, who said that it was his desire to make the reading room of the British Museum so complete and so convenient that no private library, however rich the owner, would surpass it in adaptation to reference and study.

The number of books belonging to the University at this time is 7,084 bound volumes. The cost of books and periodicals, including binding, freight, &c., has been $22,031.18.

The scientific laboratories of the University are three in number. They are open throughout the day, and are fully equipped. Chemistry has a special building, constructed in 1876-7, and well arranged for about forty workers. It contains conveniences for all kinds of chemical work, separate rooms being provided for different special branches. It has a well selected library, intended

for the use of those working in the laboratory. The physical rooms are less convenient, and are indeed inadequate to the work performed in them; but they are furnished with apparatus purchased of the best European and American makers, and selected with special reference to investigations, and still more specially for researches in respect to electricity, magnetism, and heat. In these particulars, few institutions, if any, are better supplied. A list of the instruments available here and elsewhere for precise physical experiments, has lately been printed by Harvard College. The biological laboratory has a large suite of rooms occupying the entire upper story of our building, and including a general laboratory, several private work-rooms, a lecture-room and a cabinet. This also is well supplied with new and appropriate instruments. A skilful mechanician is in the constant employ of the University for the construction and repair of apparatus. The amount expended for scientific apparatus has been $27,761.00.

In the building up of collections, mineralogical, geological, botanical, zoölogical, and ethnological, the University has scarcely made a beginning. The proximity of Baltimore to Washington makes it easy for our workers to visit the collections of the capital, those of the Smithsonian Institution being particularly attractive. There is reason also

to hope that a special contribution for a museum of natural history will be made in Baltimore by some individual or by some association, so that the funds of this University may always be free from such a charge and reserved for instruction.

3. ***Investigation and Publication.*** The experience of the last three years has justified the position which was taken at the outset of the university, that opportunity should be afforded for all who are so disposed to engage in investigations in their several departments, and that they should be encouraged to publish the results at which they arrive. It was believed that learning and teaching, inquiry and instruction should never be separated. There has been no "endowment of research," no separation of the work of the investigator from that of the teacher, no attempt to enforce the consideration of scientific or literary themes, no striving after sensational effects; but simply this, a recognition of the responsibility of the teacher to be the leader of his scholars, to show them by his own methods of work how they may work, to suggest good subjects of study and to apply to their elucidation the most skilful agencies. Accordingly, as stated already, the professors have not been too much confined by appointed duties in the class rooms; and on the other hand not one of them has been freed from positive and regular appointments as a teacher.

In the appendix some indication is given of the results of this policy.

When the time for publication came, it was found that there were no journals in this country in which extended mathematical, physiological, chemical and philological papers could be promptly published, and the trustees were therefore led to encourage the establishment of journals, the pages of which are open not only to papers from members of this university but to other contributors.

The first of these serials was the American Journal of Mathematics, of which Professor Sylvester is the editor in chief, and Dr. Story the editor in charge. The coöperation of eminent mathematicians, European as well as American, was enlisted. A quarto page was adopted, and four numbers, (making a volume of about 384 pages), were promised annually. The first volume is now completed containing forty-nine communications, eleven of which were the contributions of the chief editor and seven came from other members of this University—W. E. Story, H. A. Rowland, T. Craig, G. B. Halsted, and F. Franklin. The American contributors were S. Newcomb, C. S. Peirce, J. W. Mallet, H. T. Eddy, G. W. Hill, A. W. Phillips, and others; papers were also received from A. Cayley, W. K. Clifford, and E. Frankland of England, E. Lucas of Paris, R. Lipschitz, and G. Weichhold of Germany.

The work of the Johns Hopkins Chemical Laboratory was at first reported in a series of "Chemical Notes;" twelve of which were printed. This mode of printing has been given up and in its place the American Journal of Chemistry has been begun under the editorial supervision of Professor Ira Remsen. This is printed in octavo form; six numbers a year are promised,—three of which have already appeared,—and original contributions have been received from the laboratories of Cambridge, New Haven, Cincinnati, the University of Virginia, etc.

The papers of the Biological department of this University have been communicated to journals published elsewhere, and especially to the Journal of Physiology, published in London and Cambridge, of which Professor M. Foster is one of the editors and Professor Martin an associate editor. Five papers by H. N. Martin, W. K. Brooks, I. E. Atkinson, W. D. Booker, and H. Sewall have been collected and republished under the title "Studies from the Biological Laboratory, Session of 1877-78." The scientific results of the Chesapeake Zoölogical Laboratory, in the summer of 1878, have been published in an octavo volume of 170 pages, (with several plates)—the expenses of printing being defrayed by Messrs. S. M. Shoemaker, Enoch Pratt, J. W. Garrett, J. W. McCoy, H. N. Martin, D. C. Gilman, and others.

Professor Gildersleeve has undertaken the editorial charge of a Philological Journal and has issued a prospectus, and the publication will commence in the course of another academic year.

4. ***Examinations and degrees.*** The examinations in this University are as follows:—1. for admission; 2. for matriculation; 3. for the test of progress, prior to the Baccalaureate degree; 4. for the degree of Master of Arts and Doctor of Philosophy.

The preliminary examination is informal and may be dispensed with if the candidate is ready to matriculate. Its object is to advise the scholar as to his fitness for admission. In order to become a member of the university, in full, the candidate must be matriculated. The progress of the student is tested by semi-annual examinations in which gentlemen who have not instructed the class, as well as its teachers, participate. In the examination for the Doctor's degree, stress is laid upon the thesis, which must indicate mature and well trained abilities, and the candidate is further tested by oral questioning or by written papers proposed by the Faculty.

In 1878, four persons received the Doctor's degree as stated in the last annual report.

On June 12, 1879, the following persons were admitted to the degree of Ph. Dr.:

1. MAURICE BLOOMFIELD, of Illinois, who had received the degree of A. M. from Furman University, in Greenville, S. C , at which place he was pursuing special Oriental studies, under Prof. C. H. Toy, then of the Southern Baptist Theological Seminary. He was examined in Sanskrit, Arabic, Syriac and Hebrew, and submitted a thesis, which is to be published, on the *Noun-Formation of the Rig Veda*. His attainments were certified to, not only by the resident teachers of this university, but also by Professor W. D. Whitney, of Yale College, whose pupil he was in 1877–8.

2. SAMUEL F. CLARKE, of Illinois, whose first degree was received from Yale College, where he had pursued his studies in the Sheffield Scientific School. He has been devoted to biological research, and was examined in animal morphology and embryology, animal physiology and histology, and vegetable morphology. The subjects of his theses were (1) the *Development of Amblystoma;* and (2) a report on a collection of deep sea *Hydroids from the Gulf of Mexico*, submitted to him by Prof. A. Agassiz, of the Museum of Comparative Zoölogy, Cambridge. The second of these papers has been printed in the Bulletin of that Museum for 1879.

3. GEORGE B. HALSTED, of New Jersey, who was graduated in Princeton College in 1876, and is now a tutor of mathematics in that institution. He was examined in mathematics and logic. His thesis, entitled *Basis for a Dual Logic*, was submitted to and approved by Professor Francis Bowen, professor of logic in Harvard College.

4. EDWARD HART, of Pennsylvania, received his early training in Lafayette College, where he received a degree in 1874, and is now assistant professor of chemistry. He was examined in chemistry and physics. His thesis, the result of prolonged work in the chemical laboratory, on *Nitrosulphobenzoic Acids and their Derivatives* has been printed in the Notes from the Chemical Laboratory, No. 12, and the substance of it will also appear in the American Chemical Journal.

5. WILLIAM W. JACQUES, of Massachusetts, who was graduated in the Massachusetts Institute of Technology, Boston, in 1876. His thesis on *the Distribution of Heat in the Spectra of Various Substances*, has been published by the American Academy of Arts and Sciences. He was examined in physics and chemistry.

6. HENRY SEWALL, of Maryland, was graduated as Bachelor of Science by the Wesleyan University, at Middletown in 1876. He has been engaged in the biological laboratory, and has been examined in animal physiology and histology, and also in animal morphology and vegetable physiology. He submitted a thesis on the *Development and Regeneration of the Gastric Glandular Epithelium during fœtal life and after birth*, which has been published in the Journal of Physiology, London, Vol. IV, No. I; and also a paper on the *Physiology of Tetanus*, which is to appear in an early number of the same Journal. In his examination, Dr. H. P. Bowditch, professor of physiology in Harvard College, took part.

On the same date the following persons were admitted to the degree of Bachelor of Arts, viz:

1. GEORGE W. MCCREARY, of Baltimore, who was graduated at the City College in 1874, and has successfully completed a course of classical studies, as well as courses in physics, French and German.

2. A. CHASE PALMER, of Baltimore, who received his early training under Rev. Dr. Dalrymple, and was afterwards a member of Princeton College. He has pursued a course of classical and historical studies, and the major course in German, and has also, for a year and a half, worked with success in the chemical laboratory.

3. EDWARD H SPIEKER, who finished the course at the City College, in 1877, and has since pursued a course of classical studies, together with French and German, and a course in physics extending through one year.

5. ***Public Lectures.*** In order to extend the educational influence of the University, courses of Lectures have been opened to the public on certain conditions,—the tickets being gratuitously distributed first to members of the University, then to teachers and special students of the subjects announced, and next to gentlemen and ladies in the order of application. The teachers of the public and private schools have, in large numbers, attended some of these courses. In the following list the subjects, the number of lectures, and the average number of hearers, are given. Many of the names of the lecturers will be recognized as those of professors in other colleges, to whose coöperation this University is greatly indebted. Other courses have been given by the staff of the Johns Hopkins University, including Fellows who have, from time to time, volunteered to lecture upon subjects to which they had given particular

attention. The attendance of students has been voluntary. The lectures have been of an academic and not of a popular character, and yet they are regarded as supplementary and not as essential to the regular courses of instruction. By a residence among us of two or three years, a student, while rigidly pursuing his chosen studies, may have the opportunity of listening to able teachers in different branches of literature and science, on some aspects of their work which are of general interest.

SUMMARY OF THE PRINCIPAL COURSES OF PUBLIC LECTURES, 1876–9, (*not including many annual courses in Chemistry, Physics, Mathematics, Biology, Languages and Literature to which the public are not invited*):

	Average Attendance.
ADAMS, H. B., (Associate.)	
Religion and Government in the Ancient World, (2),	19
Beginnings of Church and State, (10),	83
ALLEN, W. F., (Prof. Univ. of Wisc.)	
History of the Fourteenth Century, (20),	96
BILLINGS, J. S., (U. S. Surg. Genl's Office.)	
History of Medicine, etc., (20),	49
BRANDT, H. C. G., (Associate.)	
German Literature prior to the Classical Period, (9),	42
BROOKS, W. K., (Associate.)	
Theories of Biology, (16),	30
CHILD, F. J., (Prof. Harv. Univ.)	
Chaucer, (20),	191
Ballads of England and Scotland, (20),	137
Shakespeare's Plays: Hamlet, Macbeth, (10),	195
COOLEY, T. M., (Prof. Univ. of Mich.)	
Torts, (20),	87
Recent Amendments to the Constitution of the United States, (6),	103
Evils in Local Government, (6),	87

	Average Attendance.
CROSS, J. M., (Associate.)	
The New Testament, (10),	12
DIMAN, J. L., (Prof. Brown Univ.)	
Thirty Years' War, (20),	192
ELLIOTT, A. M , (Associate.)	
Dante, (10),	152
FARLOW, W. G., (Prof. Harv. Univ.)	
Selected Botanical Subjects, (6),	89
GILDERSLEEVE, B L., (Professor.)	
Greek Lyric Poetry, (20),	42
Homer's Odyssey, (20),	153
Introductory to Greek Prose Literature, (12),	30
HALSTED, G. B., (Fellow.)	
Clear Thinking and its Best Modern Methods, (5),	61
HASTINGS, C. S., (Associate.)	
Theory of Sound in its Relation to Music, (6),	162
HILGARD, J. E., (U. S. Coast Survey.)	
Territorial Surveys, (20),	21
JAMES, W., (Prof. Harv. Univ.)	
The Senses and the Brain and their Relation to Thought, (10),	62
LOWELL, J. R., (Prof. Harv. Univ.)	
Dante, (20),	179
MALLET, J. W., (Prof. Univ. of Va.)	
Waste Products of Chemical Manufacture, (20),	29
History of the Chief Branches of Chemical Industry, (20),	45
MARTIN, H. N., (Professor.)	
General Biology, (20),	66
MEANS, D. McG., (Fellow.)	
The Political Situation in Eastern Europe, (4),	70
Political Economy in the United States, (4),	15
MORRIS, G. S., (Prof. Univ. of Mich.)	
General History of Philosophy, (20),	124
Topics, Historical and Practical, in Ethics, (14),	123
MURRAY, T. C., (Associate.)	
The Hebrew Scriptures, (9),	41
NEWCOMB, S., (U. S. N. Observ.)	
History of Astronomy, (20),	50
RABILLON, L., (Resident Lecturer.)	
History of the Formation of the French Language, (19),	20
History and Evolution of the French Language, (20),	48
French Romantic Literature, (11),	35
REMSEN, I., (Professor.)	
History of Chemistry, (12),	111

	Average Attendance.
ROYCE, J., (Fellow.)	
Studies on the "Return to Kant," (5),	18
Poetry of the German Romantic School, (8),	33
SAVAGE, A. D., (Fellow.)	
Cyprus and Mycenae, (8),	81
SCOTT, A., (Associate.)	
English History, (12),	37
SIHLER, E. G., (Fellow.)	
History of Greece in the 5th Century, B. C., (10),	39
Attic Life and Society, (3),	30
VON HOLST, H., (Prof. Univ. of Freiburg.)	
The German Empire, (10),	258
WALKER, F. A., (Prof. Yale College.)	
Money, (20).	49
Finance, (21),	44
WHITNEY, W. D., (Prof. Yale College.)	
Historical Development of the Inflective Structure of the Indo-European Languages, (18),	84

Less public in their character are certain courses of lectures which have been given to specialists by the teachers of the University. During the last winter Dr. Martin gave a weekly series of physiological demonstrations to the professors and students of the medical schools of Baltimore, the number of attendants being 25. Dr. Hastings, at the request of gentlemen in Washington devoted to astronomical science, gave four lectures in the Smithsonian Institution, to a company of 15 hearers, on the Mathematical Theory of the Telescope, embodying some original views of his own. Dr. T. Craig lectured to a small company chiefly consisting of civil and military engineers resident in Baltimore, on questions in hydrodynamics.

6. ***Teachers' Class in Zoölogy.*** Two courses of biological lessons, with laboratory work, designed exclusively for teachers, have been given in successive winters; the first by Professor Martin in 1877-8, on Animal Physiology, and the second in 1878-9 by Dr. Brooks on Elementary Zoölogy. An account of the class first named is given in the University Report for 1878;—an account of the second, by Dr. Brooks, is here inserted.

In conducting the Teachers' Class in Zoölogy, the plan pursued by Dr. Martin with the Teachers' Class in Physiology during the previous winter, was adopted as far as the nature of the subject permitted.

The public announcement of the course stated that "the class would be limited to school teachers or students of a Normal College who are engaged in teaching, or who purpose to teach," and in order to allow time for each student to receive personal help from the instructors, the class was limited to fifteen persons.

The following persons attended the course, all teachers in Baltimore and its vicinity, but not all teaching natural science:

Miss Emma Cowman,	Dr. C. F. Percival,	Mr. G. L. Smith,
Mr. H. Gordon,	Mr. E. H. Reade,	Miss M. B. Smyth,
Miss Isabella Hampson,	Mr Arthur Resler,	Mr. B. Sollers,
Rev. J. G. Morris,	Mr. Aug. Schmidt,	Mr. J. W. Wilson,
Miss I. J. McNeal,	Miss Scott,	Miss E. A. Yarnall.

The aim of the course was to supply at first hand, by the study of typical forms of animal life, such an acquaintance with the principles of Morphology as would be of use in teaching any branch of natural science, and the furnishing of facts, to be retailed to classes, was made a very subordinate object.

For this reason I did not attempt to restrict the course to animals which could be procured for class work, although common forms were used as far as possible.

The course of instruction included fifteen one-hour lectures and forty-five hours of laboratory work, on the mornings of fifteen Saturdays.

A series of typical forms of animal life was selected, and a descriptive lecture, illustrated by diagrams, black-board drawings and specimens, was given upon each one of them. Each student was then supplied with one or more specimens of the same animal, and with a printed sheet of directions for studying it. This paper enumerated the points to be noticed, in the order in which they are best studied, and gave directions for handling and dissecting the specimens.

Each student was also provided with the necessary dissecting apparatus; with a very simple and effective dissecting microscope designed for the purpose by Dr. Clarke, and with a compound microscope.

The following is a list of the animals which were studied:

Protozoa: Amœba, Vorticella, Paramœcium.
Cœlenterata: Fresh-water Hydra, Calcareous Sponge.
Echinoderms: Star Fish, Sea Urchin.
Annelids: Earth worm, Leech.
Arthropods: Cray Fish, Common Crab, Grasshopper.
Mollusca: Fresh-water Mussel, Oyster, Squid.

It was intended to include four vertebrates, but the above animals occupied the whole fifteen weeks.

Copies of the laboratory directions were sent to other persons engaged in similar teaching. They were used by Prof. Hyatt in the instruction to teachers given by the Boston Society of Natural History. They are used this year by Prof. Faxon in the instruction to under-graduates at the Museum of Comparative Zoölogy of Harvard College, and there have been numerous applications for them from other places.

The assistance given me by Dr. Clarke was of great value, as one person could hardly have superintended the work in the laboratory.

7. ***The Chesapeake Zoölogical Laboratory.*** This organization, under Dr. Brooks, has held its second session during the summer of 1879—attended by a select company of advanced students of zoölogy. The results of the season will soon be printed in an extended form; meanwhile, the summary given in the appendix may be read with interest. It will be noticed that the Engineer Corps of the U. S. Army, the Smithsonian Institution, the U. S. Fish Commission, and the Maryland Fish Commission, have coöperated in this work with the Johns Hopkins University.

8. ***Instruction Preliminary to Medical Studies.*** Much attention has been bestowed during the year upon the subject of a course of studies antecedent

to the study of medicine. In addition to the suggestions received from able members of the profession in this country, the Trustees have been favored with written communications from a number of eminent British surgeons, namely:

ROBERT BENTLEY, M. R. C. S., *London*, Dean of the Medical Faculty of Kings College.

G. W. CALLENDER, F. R. S., *London*, Lecturer on Surgery at St. Bartholomew's Hospital.

MICHAEL FOSTER, F. R. S., *Cambridge*, Praelector of Physiology at Trinity College.

CHRISTOPHER HEATH, F. R. C. S., *London*, Professor of Clinical Surgery at University College.

TIMOTHY HOLMES, F. R. C. S., *London*, Lecturer on Surgery at St. George's Hospital.

T. H. HUXLEY, Sec. R. S., *London*, Professor of Natural History at the Royal School of Mines.

SIR JAMES PAGET, Bart., F. R. S., *London*, President of Royal Medical Chirurgical Society.

GEORGE ROLLESTON, F. R. S., *Oxford*, Professor of Anatomy at the University of Oxford.

J. B. SANDERSON, F. R. S., *London*, Professor of Physiology at University College.

W. S. SAVORY, F. R. S., *London*, Lecturer on Surgery at St. Bartholomew's Hospital.

WILLIAM STOKES, F. R. S., *Dublin*, Professor of Physiology at the University of Dublin.

WILLIAM TURNER, F. R. C. S., *Edinburgh*, Professor of Anatomy at the University of Edinburgh.*

The views of these gentlemen were in the main unanimous, (although they were not in consultation with one another), and confirmed the Trustees in respect to the wisdom of the courses projected. The essentials of our scheme, which are explained

*Subsequently, DR. ACLAND, Regius Professor of Medicine in the University of Oxford, visited Baltimore and gave in writing his recommendations, which are about to be printed.

in the Register, include prolonged studies in Physics, Chemistry, and Biology, with ample practice in laboratories. This course can only be followed by those who have matriculated or graduated, or by a special examination have satisfied the authorities that they are sufficiently good scholars to profit by the advantages here offered. The study of English, French, German, Latin, and, if the candidate desires it, Greek, may be prosecuted in connection with scientific work,—and so of other literary subjects.

9. ***Personal Changes.*** Death has removed from the number of instructors Mr. Thomas C. Murray, an Associate Professor in the department of Shemitic languages. He died March 20, 1879, at the age of 29 years, shortly after completing a course of public lectures on the interpretation of the Hebrew Scriptures, which are soon to be published as a memorial of his life and attainments.

Mr. Murray was one of the persons earliest connected with our academic staff. For a considerable time he acted as librarian, and, to the close of his life, was active in promoting the interests of the library. He was an accurate and learned scholar, a diligent and successful teacher, and a man who lived in accordance with the highest ideal of a Christian life.

By the appointment of the Trustees, Mr. Minton Warren, Ph. D., of the University of Strasburg,

and Mr. A. S. Cook, a graduate of Rutgers College, have been made Associates, the former in Latin and the latter in English. Professor G. S. Morris has been chosen Lecturer in the History of Philosophy and in Ethics; Professor C. S. Peirce, in Logic; Professor J. W. Gibbs, in Theoretical Mechanics; and Mr. Sidney Lanier, in English Literature.

The post of Librarian, vacated by the resignation of Mr. Arthur W. Tyler, now in charge of the Public Library at Indianapolis, was temporarily filled by Mr. A. D. Savage. At the beginning of the new academic year, Dr. William Hand Browne, of Baltimore, assumes the position to which he was chosen by the Board of Trustees.

The following summary indicates the number of Students enrolled during the last three years:

	Graduates, including Fellows.	Matriculates.	Non-Matriculates.	Total.
1876–77, ...	54	12	23	89
1877–78, ...	58	24	22	104
1878–79, ...	63	25	35	123
*1879-80, ...	67	31	42	140

The following statement shows the number of persons, (in addition to enrolled Students) who have followed special, not public courses, during the past year:

Teachers attending a special class in Zoölogy, ... 15
Medical Students attending Demonstrations in Animal Physiology, . 25
Medical Students attending a Course in Animal Histology, . . 12

*At the opening of the fourth year.

Persons attending a Course in Hydrodynamics, ... 8
Persons attending a Course on the Theory of the Telescope, . . 15
Persons attending the Chesapeake Zoölogical Laboratory, . . 10

10. ***Public Assemblies.*** The twenty-second of February has been observed as the anniversary of the institution, with the following exercises:

1876. Addresses by REVERDY JOHNSON, JR., Esq., President C. W. ELIOT, of Harvard, and an Inaugural by the President of the Johns Hopkins University.
1877. Addresses by Professors SYLVESTER and GILDERSLEEVE, and the reading of a Poem by Professor JAS. RUSSELL LOWELL.
1878. Addresses by Judge GEO. WM. BROWN, Professor REMSEN and President ELIOT, of Harvard College.
1879. Address by Hon. A. D. WHITE, President of Cornell University, and an official Statement by Judge GEO. W. DOBBIN, of the Board of Trustees.

The address of President White in 1879 was an elaborate defence and exposition of the importance of university studies in Historical and Political Science. It was printed and widely distributed.

At the close of President White's address, a company of some 230 college graduates, resident in Baltimore, with the Governor of the State, the Mayor of the city, the Trustees of Johns Hopkins University, and a few invited guests, assembled in the smaller Concert Room of the Academy of Music, and partook of a collation, after which short speeches were made by the presiding officer, Hon. S. T. Wallis, LL. D., Provost of the University of Maryland, President White, Professor Von Holst, (the author of a constitutional history of the United States, who had recently completed a course

of lectures in Baltimore,) Professor Sylvester, Charles Marshall, Esq., of the Baltimore Bar, and Rev. Dr. Leeds, of Grace Church.

Degrees were conferred near the close of the academic year, in the presence of the officers and students and their personal friends.

The University has had the pleasure of receiving many visitors within the past three years, including several scientific and literary associations,—the American Philological Association, the American Institute of Mining Engineers, the Medical and Chirurgical Society of Maryland, the Teachers' Association of Baltimore County, and the College delegates of the Y. M. C. Association. Among the visits of individuals received within the past year, it is particularly pleasant to recall that of Dean Stanley, of Westminster, and his friends, who were here at the opening of our academic work in September, 1878.

Several members of the Faculty (B. L. Gildersleeve, C. S. Hastings, H. B. Adams, and D. C. Gilman) united in giving a course of lectures at the McDonogh School, to the pupils of that foundation, during the winter of 1878–9; and Professor Remsen gave a course of four lectures to mechanics and others in the room of the Academy of Sciences,—his subject being Elementary Chemistry. Dr. Martin gave a lecture before the County teacher's association, on Animal Mechanics, as an

example of how to teach Physiology in schools. Before the Medical and Chirurgical Faculty of Maryland, the annual address was given in 1878, by Professor Remsen, on Chemistry in its relations to Medicine, and in 1879, by Professor Martin, on the Physiology of Secretion.

11. ***Conclusion.*** In closing this record of the work of three years, I am confident that I express the sentiments of both the governing boards, the Trustees and the Faculty, in adding that we have had increasing reason for confidence and hope. The good will extended toward this foundation by the citizens of Baltimore and by its daily press, as well as by the leaders of educational affairs in different parts of this country, has been remarkable. The number of students constantly increases and their quality constantly improves. There has not been an occasion for the Faculty to reprimand or censure a single student. It is understood that devotion to study, and responsibility to duty are absolutely required of all the members of the University, and that those who are not willing or able to conform to this requirement, are expected to withdraw. It has never been my good fortune to live among a more earnest, diligent, and enthusiastic company of young men than those who are here assembled.

An institution like this, established without ecclesiastical or denominational support, is liable to be misunderstood and misinterpreted,—sometimes even by its very best friends. We have not been free from animadversions; but the authorities have preferred to say nothing in recrimination and but little in self-defence.

The character, aim, and influence of the University foundation must be discovered in the conduct and utterances of those who administer its affairs, and by its dominant efforts through a course of years. Fortunate will it be if teachers and pupils are uniformly found on the side of righteousness and truth; if the voice of the University is never heard in the defence of error, falsehood or pretence; and if all who administer its affairs are reverent toward God and faithful toward man. Such an institution, by unfolding the laws of nature, by discovering principles hitherto hidden, by interpreting history, and by strengthening the foundations of intellectual, moral and religious character, will deserve the support of all good men, under whatever ecclesiastical banner they may choose to be enrolled.

Respectfully submitted,

D. C. GILMAN,

President of the Johns Hopkins University.

BALTIMORE, *September 1, 1879.*

APPENDIX.

A.

Academic Staff.

PRESIDENT.

Appointed		
Dec. 30, 1874.	DANIEL C. GILMAN.	

PROFESSORS.

Jan. 3, 1876.	BASIL L. GILDERSLEEVE,	*Greek.*
Mar. 5, 1876.	J. J. SYLVESTER, . .	*Mathematics.*
April 17, 1876.	IRA REMSEN, . . .	*Chemistry.*
April 17, 1876.	HENRY A. ROWLAND, .	*Physics.*
Sept. 4, 1876.	H. NEWELL MARTIN, .	*Biology.*
Sept. 4, 1876.	CHARLES D. MORRIS, .	*Classics.*

ASSOCIATES.

April 3, 1876.	JOHN M. CROSS, . .	*Greek.*	
April 3, 1876.	PHILIP R. UHLER, . .	*Natural History.*	
April 17, 1876.	AUSTIN SCOTT, . .	*History.*	
June 5, 1876.	A. MARSHALL ELLIOTT,	*Modern Philology.*	
June 5, 1876.	THOMAS C. MURRAY, .	*Shemitic.*	*1879.*
Sept. 4, 1876.	HERMAN C. G. BRANDT, .	*German.*	
Sept. 4, 1876.	WILLIAM K. BROOKS, .	*Biology.*	
Sept. 4, 1876.	HARMON N. MORSE, .	*Chemistry.*	
Sept. 4, 1876.	ROBERT RIDGWAY, . .	*Natural History.*	*1877.*
Sept. 4, 1876.	WILLIAM E. STORY, .	*Mathematics.*	
Sept. 4, 1876.	ARTHUR W. TYLER, .	*Librarian.*	*1878*
Oct. 2, 1876.	CHARLES S. HASTINGS, .	*Physics.*	
May 7, 1877.	CHARLES R. LANMAN, .	*Sanskrit.*	
June 3, 1878.	HERBERT B. ADAMS, .	*History.*	
June 12, 1879.	ALBERT S. COOK, . .	*English.*	
June 12, 1879.	MINTON WARREN, . .	*Latin.*	
July 7, 1879.	WILLIAM HAND BROWNE,	*Librarian.*	

LECTURERS.

Appointed			Courses.
1876.	JOHN S. BILLINGS,	*Medical History, etc.*	One.
1876.	FRANCIS J. CHILD,	*Early English, etc.*	Three.
1876.	THOMAS M. COOLEY,	*Law.*	Three.
1876.	JULIUS E. HILGARD,	*Geodetic Surveys.*	One.
1876.	JAMES RUSSELL LOWELL,	*Romance Literature.*	One.
1876.	JOHN W. MALLET,	*Technological Chemistry.*	Two.
1876.	SIMON NEWCOMB,	*Astronomy.*	One.
1876.	LÉONCE RABILLON,	*French.*	Three.
1876.	FRANCIS A. WALKER,	*Political Economy.*	Two.
1876.	WILLIAM D. WHITNEY,	*Comparative Philology.*	One.
1877.	WILLIAM F. ALLEN,	*History.*	One.
1878.	WILLIAM JAMES,	*Psychology.*	One.
1878.	GEORGE S. MORRIS,	*Philosophy.*	Two.
1878.	J. LEWIS DIMAN,	*History.*	One.
1878.	H. VON HOLST,	*History.*	One.
1878.	WILLIAM G. FARLOW,	*Botany.*	One.
1879.	J. WILLARD GIBBS,	*Theoretical Mechanics.*	
1879.	SIDNEY LANIER,	*English Literature.*	
1879.	CHARLES S. PEIRCE,	*Logic.*	

ASSISTANTS.

1876.	HENRY SEWALL,	*Biological Laboratory. 1878.*
1879.	SAMUEL F. CLARKE,	*Biological Laboratory.*
1879.	FABIAN FRANKLIN,	*Mathematics.*
1879.	LYMAN B. HALL,	*Chemical Laboratory.*
1879.	CHRISTIAN SIHLER,	*Biological Laboratory.*

FELLOWS.

1. HENRY CARTER ADAMS (*Political Science, 1876–79*), from Waterloo, Iowa; A. B., Iowa College, 1874, and A. M., 1877; Ph. D., Johns Hopkins, 1878; *Lecturer upon Finance at Cornell University, Ithaca, N. Y., 1879–80.*

History of Taxation in the United States, (*Graduating thesis, J. H. U., 1878*), published under the title, Zur Geschichte der Besteuerung in den Vereinigten Staaten von Amerika in der Periode von 1789–1816. (*Zeitsch. f. d. gesam. Staatswissenschaft, Tübingen, 1879.*)
Coöperation. (*Am. Soc. Sc. Assoc., 1878.*)
Historical Position of Socialism in the Development of Political Economy. (*Penn Monthly, 1879.*)

2. HERBERT BAXTER ADAMS (*History, 1876-78*), from Amherst, Mass.; Phillips Academy, Exeter, N. H., 1868; A. B., Amherst, 1872; Instructor at Williston Seminary, Easthampton, Mass., 1872-73; Student of History and Political Science at

Heidelberg, and Berlin, 1873-76; Ph. D., Heidelberg, 1876; Lecturer on History at Smith College, Northampton, Mass., 1878-80; *Associate in History, 1878-80.*

Maryland's Influence in Founding a National Commonwealth, or the History of the Accession of Public Lands by the Old Confederation. (*Maryland Historical Society, 1877.*)

3. William Keith Brooks (*Biology, 1876*), from Cleveland, Ohio; A. B., Williams, 1870; Ph. D., Harvard, 1874; Assistant, Boston Society of Natural History, 1874-75; *Associate in Biology, 1876-80.*

On an Organ of Sense in the Lamellibranchiate Genus Yoldia. (*Proc. Amer. Assoc., 1874.*)
Embryology of the Fresh-Water Mussel. (*Proc. Amer. Assoc., 1875.*)
Embryology of Salpa. (*Proc. Boston Soc. Nat. Hist., 1875.*)
The Affinity of the Mollusca and the Molluscoida. (*Proc. Boston Soc. Nat. Hist., 1875.*)
The Development of Salpa. (*Bull., Mus. Comp. Zoöl., Cambridge, No. 14.*)
A Remarkable Life-History. (*Amer. Nat., Nov., 1876.*)
A Provisional Hypothesis of Pangenesis. (*Amer. Nat., March, 1877.*)
Parthenogenesis in Vertebrates and Molluscs. (*Amer. Nat., Oct., 1877.*)
Preliminary Observations upon the Development of the Marine Prosobranchiate Gasteropods. (*Studies from the Biol. Lab., J. H. U., 1879.*)
The Development of Lingula and the Systematic Position of the Branchiopods. (*Scientific Results, Chesapeake Zoöl. Lab., 1879.*)
The Larval Stages of Squilla empusa. (*Scientific Results, Chesapeake Zoöl. Lab , 1879.*)

4. Thomas Craig (*Mathematics, 1876–78; Physics, 1878–79*), from Pittston, Pa.; C. E., Lafayette, 1875; Ph. D., Johns Hopkins, 1878; *Tidal Division, U. S. Coast and Geodetic Survey, 1879–80.*

Representation of one Surface upon another, and on some points in the Theory of the Curvature of Surfaces. (*Graduating Thesis, J. H. U., 1878.*)
Motion of a Point upon the Surface of an Ellipsoid. (*Am. Jour. of Math., 1878.*)
Mathematical Theory of Fluid Motion. (*Van Nostrand's Eng. Mag., 1879.*)
Motion of a Solid in a Fluid. (*Am. Jour. of Math., 1879.*)
General Differential Equation for Developable Surfaces. (*Jour. of Franklin Inst., 1879.*)
Treatise on the Mathematical Theory of Projections. (*U. S. Coast Survey, 1879.*)
Projection of the General Locus of Space of Four Dimensions into Space of Three Dimensions. (*Am. Jour. of Math., 1879.*)
Motion of an Ellipsoid in a Fluid. (*Am. Jour. of Math., 1879.*)

5. Joshua Walker Gore (*Mathematics, 1876–78*), from Frederick County, Virginia; C. E., University of Virginia, 1875; *Professor of Natural Science, Southwestern Baptist University, Jackson, Tenn., 1878–80.*

6. George Bruce Halsted (*Mathematics, 1876–78*), from New York City; A. B., Princeton, 1875, and A. M., 1878; Fellow of Princeton College, and Student at School of Mines, Columbia College, 1875–76; Student at Berlin, 1877; Ph. D., Johns Hopkins, 1879; *Tutor in Princeton College, 1878–80.*

Basis for a Dual Logic. (*Graduating Thesis, J. H. U., 1879.*)
Spencer's Classification of the Abstract Sciences. (*Popul. Sc. Mon., 1877.*)
The New Ideas about Space. (*Popul. Sc. Mon., 1877.*)
Bibliography of Hyper-Space and Non-Euclidean Geometry. (*Am. Jour. of Math., 1878–79.*)
Note on the First English Euclid. (*Am. Jour. of Math., 1879.*)
Historical Sketch of Exact Rectilinear Motion. (*Van Nostrand's Eng. Mag., 1878.*)
Mechanical Conversion of Motion. (*Van Nostrand's Eng. Mag., 1878; reprinted in "World of Science," London.*)
Jevons's Criticism of Boole's Logic. (*Mind, 1878.*)
Boole's Logical Method. (*Jour. of Spec. Philos., 1878.*)
Statement and Reduction of Syllogism. (*Jour. of Spec. Philos., 1878.*)
Algorithmic Division in Logic. (*Jour. of Spec. Philos., 1879.*)

7. EDWARD HART (*Chemistry, 1876–78*), from Doylestown, Pa.; S. B., Lafayette, 1874; Ph. D., Johns Hopkins, 1879; *Assistant Professor in Chemistry, Lafayette College, 1878–80.*

Nitrosulphobenzoic Acids and their Derivatives. (*Graduating thesis, J. H. U., 1879; notes from Chem. Lab., J. H. U., 1878.*)
Volumetric Estimation of Sulphuric Acid. (*American Chemist, VI, 284.*)
Volumetric Estimation of Iron. (*Chem. News, XXXIV, p. 65.*)
Ueber Isomere Sulfosaüren aus Paranitrotoluene. (*Ber. d. Deut. Chem. Ges., X, 1046; notes from Chem. Lab., J. H. U., 1877.*)
Handbook of Volumetric Analysis. (*N. Y. Wiley, 1878.*)
Stopcock of Easy Construction. (*Am. Chem. Jour., 1879.*)

8. DANIEL WEBSTER HERING (*Engineering. 1876–78*), from Mechanicstown, Md.; Ph. B., Yale, 1872; Assistant Engineer, Berks County Railroad, Pa., 1873–74; C. E., Yale, 1878; *Assistant Engineer, Baltimore and Cumberland Valley Railroad, Waynesboro', Pa., 1878–80.*

9. MALVERN WELLS ILES (*Chemistry, 1876–78*), from Davenport, Iowa; Ph. B., Columbia, 1875, and Ph. D., 1876; *Chemist, Leadville, Colorado.*

A New Qualitative Reaction for Boracic Acid. (*Am. Chemist, 1876.*)
On the Action of Ozone upon Milk. (*Sc. Amer., 1877.*)
On the Oxidation of Sulpho-Acids derived from Metaxylene. (*Notes from Chem. Lab., J. H. U., 1877.*)
On the Oxidation of Xylenesulphonic Acids. (*Notes from Chem. Lab., J. H. U., 1877–78.*)
A New Method for the Quantitative Estimation of Sulphur. (*Notes from Chem. Lab., 1878.*)

10. WILLIAM WHITE JACQUES (*Physics, 1876–79*), from Newburyport, Mass.; S. B., Mass. Institute of Technology 1876; Ph. D., Johns Hopkins, 1879; *Fellow by Courtesy and Resident Student, 1879–80.*

Light Transmitted by One or More Plates of Glass. (*Am. Acad., 1875.*)
Answer to M. Jamin's Objections to Ampère's Theory. (*Am. Acad., 1875.*)
Diffraction of Sound. (*Am. Acad., 1876.*)
An Experimental Proof of the Law of Inverse Squares for Sound. (*Am. Acad., 1876.*)
Effect of the Motion of Air within an Auditorium upon its Acoustic Qualities. (*Jour. Franklin Inst., 1878.*)
Velocity of Very Loud Sounds. (*Am. Jour. of Science, 1879.*)
Diamagnetic Constants of Bismuth and Calc Spar Crystals in Absolute Measure. (*Am. Jour. of Science, 1879.*)
Distribution of Heat in the Spectra of Various Sources of Radiation. (*Graduating thesis, J. H. U., 1879; Am. Acad., 1879.*)

11. CHARLES ROCKWELL LANMAN (*Sanskrit, 1876–77*), from Norwich, Conn.; A. B., Yale, 1871, and Ph. D., 1873; Student at Berlin, 1873–74; Tübingen, 1874–75; Leipzig, 1875–76; Secretary and Curator of the American Philological Association, 1879–80; *Associate for Sanskrit, 1877–80.*

Contributions to Grassmann's Wörterbuch zum Rig-Veda. (*Leipzig, 1873–75.*)
Compendium of Sanskrit Paradigms. (1876.)
A Conjectural Emendation of Rig-Veda i. 30. 11. (*Am Or. Soc. Proc., 1877.*)
On Tentative Linguistic Forms. (*Am. Or. Soc. Proc., 1878.*)
Noun-Inflection in the Veda. (*Am. Or. Soc. Jour., Vol. X., pp. 325–615.*)

12. DAVID MCGREGOR MEANS (*Political Science, 1876–77*), from Andover, Mass.; A. B., Yale, 1868; *Professor of Political and Mental Science in Middlebury College, Vermont.*

13. Harmon Northrup Morse (*Chemistry, 1876*), from Cambridge, Vt.; A. B., Amherst, 1873; Ph. D., Göttingen, 1875; Instructor in Chemistry in Amherst College, 1875–76; *Associate in Chemistry, 1876–80.*

Benzoylamidophenols. (*Ber. d. Deut. Chem. Ges., 1874.*)
Ueber Einige Derivate des Ortho- und Paramidophenols. (*Inaug. Dissertation, Göttingen, 1875.*)
On the Oxidation of Bromethyltoluene and of Similar Substitution Products. (*Notes from Chem. Lab., J. H. U., 1877.*)
On Acetylamidophenols by Reduction of Ortho- and Paranitrophenols by means of Glacial Acetic Acid and Tin. (*Notes from Chem. Lab., J. H. U., 1877.*)

14. Walter Hines Page (*Greek, 1876–78*), from Cary, N. C.; Randolph-Macon, Va., 1876; Assistant Professor of Greek and English in Randolph-Macon College, 1875–76; Lecturer to the N. C. Normal College, 1878; Professor in Louisville (Ky.) Male High School, 1878–79; *Cary, N. C.*

15. P. Porter Poinier (*Physics, 1876*), from Newark, N. J.; M. E., Stevens Inst., 1874. *Died, without entering upon the Fellowship, June, 1876, aged 23 years.*

Formulæ for the Apparent Specific Heat of Saturated Vapors. (*Jour. Frank. Inst., 1875.*)

16. Erasmus Darwin Preston (*Engineering, 1876–78*), from Spruce Grove, Pa.; B. C. E., Cornell, 1875; Assistant Engineer Cornell University Hydraulic Works, 1875; Instructor in Cornell University, 1875–76; *Aid, United States Coast Survey, 1878–80.*

17. Henry Joseph Rice (*Biology, 1876–78*), from Cazenovia, N. Y.; S. B., Cornell, 1876; *Assistant, U. S. Fish Commission, 1879.*

Observations upon the Hatching, Variation, and Development of the Raritan River Smelt, Osmerus eperlanus. (*Md. Fish Commission, 1878.*)
Notes upon the Development of the Shad, Alosa sapidissima. (*Md. Fish Commission, 1878.*)

18. Josiah Royce (*Philosophy, 1876–78*), from Oakland, Cal.; A. B., Univ. of California, 1875; Ph. D., Johns Hopkins, 1878; *Assistant Professor of Literature in the University of California, Berkeley, Cal.*

Interdependence of the Principles of Human Knowledge. (*Graduating thesis, J. H. U., 1878.*)

19. Ernest Gottlieb Sihler (*Greek, 1876–79*), from Fort Wayne, Ind.; Concordia College [German Gymnasium, Fort Wayne], 1869; Student of Classic Philology at Berlin and Leipsic, 1872–75; Ph. D., Johns Hopkins, 1878; *Classical Instructor in Dr. J. Sachs' Collegiate Institute, New York City, 1879–80.*

Plato's Use of Metaphor and Comparison. (*Graduating thesis, J. H. U., 1878.*)
Herodotus, Æschylus and the Battle of Salamis. (*Am. Philol. Assoc., 1877.*)
The Rhetorical and Critical Labors of Dionysius of Halicarnassus. (*Am. Philol. Assoc., 1879.*)

20. Frederick Boyd Van Vorst (*Ethics and Metaphysics, 1876–77*), from New York City; A. B., Princeton, 1875; Fellow

in Metaphysics in Princeton College, 1875–76; *Attorney-at-Law, New York City.*

21. JOHN HENRY WHEELER (*Philology, 1876–77*), from Auburn, Mass.; A. B., Harvard, 1871, and A. M., 1875; Fellow in Classics of Harvard College, 1877; Student at Leipsic, and Bonn, 1877–78; Ph. D., Bonn, 1879.

De Alcestidis et Hippolyti Euripidearum Interpolationibus. (*Doctor's dissertation, printed at Bonn, 1879.*)

22. SAMUEL FESSENDEN CLARKE (*Biology, 1876–79*), from Geneva, Ill.; Assistant Zoölogist U. S. Fish Commission, 1874–75; Assistant in Zoölogy in Sheffield Scientific School, 1874–76; Ph. B., Yale, 1878; Ph. D., Johns Hopkins, 1879; *Assistant in Biological Laboratory, 1879–80.*

New and Rare Species of Hydroids from the New England Coast. (*Conn. Acad., 1875.*)
New Hydroids of the Pacific Coast of the U. S., South of Vancouver Island. (*Conn. Acad., 1876.*)
Hydroids of Alaska. (*Acad. Nat. Sc., Phila., 1876; Smithsonian Institution, 1876.*)
Hydroids of the Gulf Stream and Gulf of Mexico. (*Mus. Comp. Zoöl., Camb., Mass., 1879.*)
Development of Amblystoma punctatum, Baird. (*Biol. Lab., J. H. U., 1879.*)

23. LYMAN BEECHER HALL (*Chemistry, 1877–79*), from New Bedford, Mass.; Phillips Academy, Andover, Mass., 1869; A. B., Amherst, 1873; Ph. D., Göttingen, 1875; *Assistant in Chemical Laboratory, 1879–80.*

Ueber Orthonitrosalicysäure und einige Abkömmlinge derselben. (*Inaugural Dissertation, Göttingen, 1875.*)
On the Oxidation of Mesitylene-Sulphonic Acid (*Notes from Chem. Lab., J. H. U., 1877; Ber. d. Deut. Chem. Ges., X.*)
On the Oxidation of Substitution Products of Mesitylene. (*Notes from Chem. Lab., J. H. U., 1878.*)
Ueber Oxidationsprodukte aus Cymosulfamid. (*Ber. d. Deut. Chem. Ges., XII.*)

24. ALEXANDER DUNCAN SAVAGE (*Greek, 1876–79*), from Pass Christian, Miss.; B. Litt., University of Virginia, 1870; A. M., Yale, 1877; *Assistant of the Director of the Metropolitan Museum of Art in New York, 1879–80.*

The "Oath of Rhadamanthus." (*Am. Philol. Assoc., 1878.*)
Discussion of the Periods to which the Egyptian and Assyrian Statues of Ancient Cyprus shall be assigned. (*Metropolitan Museum, N. Y., 1879.*)

25. FABIAN FRANKLIN (*Mathematics, 1877–79*), from Baltimore, Md.; Ph. B., Columbian University, 1869; Engineer Corps, Pittsburg and Connellsville Railroad, 1870–71; City Surveyor's Office, Baltimore, 1871–77; *Assistant in Mathematics, 1879–80.*

Bipunctual Coördinates. (*Amer. Jour. of Math., 1878.*)
Notes on Partitions of Numbers, etc. (*Am. Jour. of Math., 1878; 1879.*)

26. CHRISTIAN SIHLER (*Biology, 1877–79*), from Fort Wayne, Ind.; Concordia, 1866; M. D., University of Michigan, 1871; *Assistant in Biological Laboratory, 1879–80.*

On the so-called Heat-Dyspnoea. (*Jour. of Physiol., 1879.*)

27. FRANCIS GREENLEAF ALLINSON (*Greek and Sanskrit, 1877–80*), from Burlington, N. J.; A. B., Haverford, 1876, and

A. M., 1879; A. B., Harvard, 1877; Temporary Instructor in Greek at Haverford College, 1878.

28. Maurice Bloomfield (*Sanskrit and Greek, 1878–79*), from Chicago, Ill.; A. M., Furman University, (S. C.), 1877; Ph. D., Johns Hopkins, 1879; *Fellow by Courtesy, Johns Hopkins University, and Student of Philology at Vienna, 1879–80.*

Noun-Formation of Rig Veda. (*Graduating Thesis, J. H. U., 1879.*)

29. Constantine Fahlberg (*Chemistry, 1878–80*), from Tambow, Russia; Ph. D., Leipsic, 1873; Director of the United Brunswick-Hanover Metallurgical Laboratory, Oker, Harz-Mountains, 1874–75; Analytical and Consulting Chemist, New York City, 1875–76; Assistant in Dr. Halse's Technological Laboratory, London, 1876–77; Chemist of the Colonial Company, London and Demerara (South America), 1877–78.

Determination of Calcium Monosulphide in Boneblack. (*Zeitsch. f. analyt. chem. 1871.*)
On Oxyacetic Acid. (*Dissertation, Leipsic, 1873; Kolbe's Jour., 1873.*)
New Method for the Volumetric Estimation of Zinc. (*Zeitsch. f. analyt. chem., 1875.*)
Description of the Manufacture of Cane Sugar in Demerara. (*Royal Gazette, 1877.*)
Method for the Manufacture of Zinc Carbonate from Zinc Sulphate. (*U. S. Patent Office, 1878.*)
A New Method for the Quantitative Estimation of Sulphur. (*Notes from Chem. Lab., J. H. U., 1878.*)
On the Oxidation of Tolueneorthosulphamide. (*Ber. d. Deut. Chem. Ges., 1878.*)
On the Liquid Toluenesulphochloride. (*Am. Chem. Jour., 1879.*)

30. Edwin Herbert Hall (*Physics, 1878–80*), from Gorham, Maine; A. B., Bowdoin, 1875; Graduate Student of Physics at Johns Hopkins University, 1877–78.

On a New Action of the Magnet on Electric Currents. (*Am. Jour. of Math., 1879.*)

31. Edward Coles Harding (*Greek, 1878–79*), from Northumberland County, Va.; A. M., University of Virginia, 1876; *Lottsburg, Northumberland County, Virginia.*

32. Isaac Ott (*Biology, 1878–79*), from Easton, Pa.; M. D., University of Pennsylvania, 1869; Resident Physician in St. Mary's Hospital, Philadelphia, 1870; Lecturer on Experimental Physiology in the University of Pennsylvania, 1876–77; A. M., Lafayette, 1877; *Physician, Easton, Pa.*

Cocain, Veratria and Gelsemium. (*Phila., 1874.*)
Rapidity of Transmission of Nerve Force in Normal and Stretched Nerves. Extra Polar Katelectrotonus. (*Jour. of Nervous and Mental Diseases.*)
The Action of Medicine. (*Phila., Lindsay, 1868.*)
Sweat-Centres. The Action of Muscarin and Atropin on them. (*Jour. of Physiol., 1878.*)
Observations on the Spinal Cord. (*Biol. Lab., J. H. U.; Jour. of Physiol., 1879.*)

Also a large number of minor contributions to Phila. Med. Times; Boston Med. Journal; Jour. of Nerv. and Ment. Diseases, etc.

33. Henry Sewall (*Biology, 1878–79*), from Baltimore; S. B., Wesleyan, 1876; Graduate Student of Biology, and Assistant in Laboratory, at Johns Hopkins University, 1876–78; Ph. D., Johns Hopkins, 1879; *Fellow by Courtesy, Johns Hopkins University, and Student of Biology, at Leipsic, 1879–80.*

Development and Regeneration of Gastric Glandular Epithelium during Fœtal Life and after Birth. (*Jour. of Physiol., 1878.*)
On the effect of Two Succeeding Stimuli upon Muscular Contraction. (*Jour. of Physiol., 1879.*)

34. WASHINGTON IRVING STRINGHAM (*Mathematics, 1878–80*), from Topeka, Kansas; A. B., Harvard, 1877.

Investigations in Quaternions. (*Am. Acad., 1878.*)
Some General Formulae for Integrals of Irrational Functions. (*Am. Jour. of Math., 1879.*)
The Quaternion Formulae for Quantification and for Barycentres. (*Am. Jour. of Math., 1879.*)

35. ABRAM VAN EPPS YOUNG (*Chemistry, 1878–80*), from Grand Rapids, Mich.; Ph. B., University of Michigan, 1875; Assistant in Chemistry and Physics in the University of Michigan, 1875–77.

36. CHARLES ROBERT HEMPHILL (*Greek, 1878–79*), from Chester, S. C.; University of South Carolina, 1869; University of Virginia, 1871; Southern Presbyterian Theological Seminary, 1874, and Tutor in Hebrew in same, 1874–78; A. M., Davidson, 1878; *Professor of Ancient Languages in the Southwestern Presbyterian University, Clarksville, Tenn.*

37. ALLAN MARQUAND (*Logic and Ethics, 1878–80*), from New York City; St. Paul's School, Concord, N. H., 1871; A. B., Princeton, 1874; Tutor in Princeton College, 1876; Union Theological Seminary, New York, 1877; Student at Berlin, 1877-78.

38. CHARLES AMBROSE VAN VELZER (*Mathematics, 1878–80*), from Ithaca, N. Y.; S. B., Cornell, 1876; Instructor in Mathematics at Cornell University, 1876–77.

39. BROWN AYRES (*Physics, 1879–80*), from New Orleans, La.; S. B., Stevens Inst. of Technology, 1878; Graduate Student of Mathematics and Physics at Johns Hopkins University, 1878–79.

The Gramme Machine. (*Sc. Amer. Supp., 1876.*)
The Telephone. (*Jour. of Franklin Inst., 1878.*)
New Arrangement for Telephone. (*Sc. Amer. Supp., 1878.*)
Two New Forms of Bell Telephone. (*Jour. of Franklin Inst., 1878.*)

40. LOUIS BEVIER (*Greek, 1879–80*), from New Brunswick, N. J.; A. B., Rutgers, 1878; Graduate Student of Greek at Johns Hopkins University, 1878–79.

41. EDWARD MUSSEY HARTWELL (*Biology, 1879–80*), from Littleton, Mass.; Public Latin School, Boston, Mass., 1869; A. B., Amherst, 1873, and A. M., 1876; Vice-Principal of High School, Orange, N. J., 1873–74; Instructor in Public Latin School, Boston, 1874–77; Student in Miami Medical College, Cincinnati, Ohio, 1877–78; Graduate Student of Biology and Chemistry at Johns Hopkins University, 1878–79.

The Function of the Internal Intercostal Muscles. (*Conjointly with Prof. H. N. Martin, Jour. of Physiol., 1879.*)

42. JOHN ROBIN MCDANIEL IRBY (*Mineralogy, 1879–80*), from Lynchburg, Va.; Miller Scholar of University of Virginia,

1873–75; S. B., University of Virginia, 1875; Ph. D., Göttingen, 1878.

Eine kritische Untersuchung ueber die bei dem kalkspath vorkommenden Skalenoeder. (*Prize Essay of the University of Bonn, 1877, expanded and published under the title* On the Crystallography of Calcite, *Bonn, A. Marcus, 1878; abstract in Groth's Zeitschrift, Bd. III.*)

43. Mitsuru Kuhara (*Chemistry, 1879–80*), from Tsuyama, Japan; Assistant in Chemical Laboratory in University of Tokio, Japan, 1878–79; Rigaku Shi, (S. B.), University of Tokio, 1879.

On the Red Colouring Matter of the Lithospernum erythrorhizon. (*Jour. of Chem. Soc., London, 1879.*)

44. Oscar Howard Mitchell (*Mathematics, 1879–80*), from Marietta, Ohio; A. B., Marietta, 1875, and A. M., 1878; Principal of High School at Marietta, 1875–78; Graduate Student of Mathematics at Johns Hopkins University, 1878–79.

45. Edward Leamington Nichols (*Physics, 1879–80*), from Peekskill, N. Y.; S. B., Cornell, 1875; Student of Physics at Leipsic, Berlin, and Göttingen, 1875–79; Ph. D., Göttingen, 1879.

Ueber die Volumenvermehrung der Flüssigkeiten durch Absorption von Gasen. (*Pogg. Annalen, 1878, N. F., Bd. 3.*)

Ueber das von glühendem Platin ausgestrahlte Licht. (*Inaugural Dissertation, Göttingen, 1879.*)

Papers on Radiation. (*Am. Jour. of Science, 1879.*)

46. Waldo Selden Pratt (*Æsthetics and the History of Art, 1879–80*), from Williamstown, Mass.; Phillips Academy, Andover, Mass., 1874; A. B., Williams, 1878; Graduate Student of Greek and Archæology at Johns Hopkins University, 1878–79.

47. William Thomson Sedgwick (*Biology, 1879–80*), from Farmington, Conn.; Ph. B., Yale, 1877; Student in Yale Medical School, 1877–78; Instructor in Physiological Chemistry and Toxicology in Sheffield Scientific School, 1878–79.

48. Herman Voorhees (*Chemistry, 1879*), from Troy, New York; C. E., Rensselaer Polytechnic Inst., 1873; Graduate Student of Chemistry at Johns Hopkins University, 1878–79. *Died October 14, 1879, without entering on the Fellowship, aged 27 years.*

49.* Charles Otis Whitman (*Biology, 1879*), from Newton Highlands, Mass.; A. B., Bowdoin, 1868, and A. M., 1871; Ph. D., Leipsic, 1878; *Professor of Zoölogy in the University of Tokio, Japan.*

The Embryology of Clepsine. (*Quart. Mic. Jour., London, 1878.*)

50. Edmund Beecher Wilson (*Biology, 1879–80*), from Geneva, Ill.; Ph. B., Yale, 1878; Assistant in Zoölogy at Yale College, 1877–79.

Description of two New Genera of Pycnogonida. (*Am. Jour. of Science, 1878.*)

The Pycnogonida of New England and Adjacent Waters. (*U. S. Fish Comm. Report, 1877.*)

* Did not enter upon the Fellowship.

51. GEORGE FREDERICK NICOLASSEN (*Greek, 1879–80*), from Baltimore, Md.; A. B., University of Virginia, 1879.

Appointed since September 1, 1879.

52. WILLIAM BURNEY (*Chemistry, 1879–80*), from Davidson College, N. C.; S. B., Davidson, 1875; Ph. D., Heidelberg, 1879.

53. ROBERT WOODWORTH PRENTISS (*Mathematics, 1879–80*), from New Brunswick, N. J.; S. B., Rutgers, 1878; Graduate Student of Mathematics at Johns Hopkins University, 1878–79.

Dr. Brooks and Dr. Morse were appointed Associates before entering upon the Fellowships.

GRADUATES.

DOCTORS OF PHILOSOPHY.

1878.

HENRY C. ADAMS, . (*Fellow in Political Science, 1876–9.*)
THOMAS CRAIG, . . . (*Fellow in Physics, 1876–9.*)
JOSIAH ROYCE, . . . (*Fellow in Philosophy, 1876–8.*)
ERNEST G. SIHLER, . . . (*Fellow in Greek, 1876–9.*)

1879.

MAURICE BLOOMFIELD. (*Fellow in Sanskrit and Greek, 1878–9.*)
SAMUEL F. CLARKE, . . . (*Fellow in Biology, 1877–9.*)
GEORGE B. HALSTED, . . (*Fellow in Mathematics, 1876–8.*)
EDWARD HART, . . (*Fellow in Chemistry, 1876–8.*)
WILLIAM W. JACQUES, . . (*Fellow in Physics, 1876–9.*)
HENRY SEWALL, . . . (*Fellow in Biology, 1878–9.*)

BACHELORS OF ARTS.

1879.

GEORGE W. MCCREARY, . . (*Balt. City College, 1874.*)
Matriculated Student, 1st, 2d, and 3d Academic Years, 1876–9.

A. CHASE PALMER, ... (*Princeton College.*)
Matriculated Student, 1st, 2d, and 3d Academic Years, 1876–9.

EDWARD H. SPIEKER, . . . (*Balt. City College, 1877.*)
Matriculated Student, 2d, and 3d Academic Years, 1877–9.

UNIVERSITY SCHOLARS.

1876.

GEORGE W. MCCREARY, . (*Balt. City College.*) Baltimore.
ALLDIN M. SPRIGG, . . (*St. John's College.*) Cumberland.

1877.

EDWARD H. SPIEKER, . (*Balt. City College.*) Baltimore.

1878.

WILLIAM W. BADEN, . . . (*Steuart Hall.*) Baltimore.
JOHN W. BROWN, . (*Mr. G. G. Carey's School.*) Govanstown.

GRADUATE SCHOLARS.

1879.

A. CHASE PALMER, . . . (*A. B., 1879.*) Baltimore.
EDWARD H. SPIEKER, . . . (*A. B., 1879.*) Baltimore.

B.

Enumeration of Classes which have been instructed during the Academic Year 1878-9.

The following list shows the principal classes which have been organized and instructed during the year:

The figures given in parenthesis indicate in the case of classes the number of students, and in the case of public lectures the average number of auditors.

Mathematics. (38 Students.)

Determinants and Modern Algebra (8). *Twice weekly, through the year: Prof. Sylvester.*
Mathematical Seminary (12). *Once monthly, through the year: Prof. Sylvester and Dr. Story.*
Elliptic Functions (2). *Twice weekly, through the year: Dr. Story.*
Higher Plane Curves (6). *Thrice weekly, first half year: Dr. Story.*
Solid Analytic Geometry (7). *Thrice weekly, second half year: Dr. Story.*
Differential Equations (5). *Twice weekly, through the year: Dr. Story.*
Differential and Integral Calculus (12). *Thrice weekly, through the year: Mr. Franklin.*
Analytic Geometry (Conics) (5). *Thrice weekly, through the year: Mr. Franklin:—Instruction given chiefly by lectures from notes prepared by Dr. Story.*
Theory of Equations (1). *Twice weekly, first half year: Mr. Franklin.*

The results of special studies upon the following subjects, among others, have been examined and discussed in the Mathematical Seminary, under the direction of Prof. Sylvester and Dr. Story:—Newton's rule for the limits of roots of algebraic equations; the rule of signs in trigonometry; barycentric coördinates; double points of plane curves; the quasi evolute; central harmonic transformation; special cases of Pascal's hexagram; transformation by elliptic coördinates.

Physics. (32 Students.)

General Physics (19). *Two experimental lectures and three recitations weekly, through the year: Dr. Hastings.*

Thermodynamics (7). *Thirty mathematical lectures and ten recitations: Prof. Rowland.*

Electricity and Magnetism (3). *Eighty mathematical lectures and twenty-seven recitations: Prof. Rowland.*

Theoretical Dynamics (6). *Fifteen mathematical lectures: Dr. Craig.*

Spherical Harmonics (6). *Ten mathematical lectures: Dr. Craig.*

Hydrodynamics (7). *Twenty-four mathematical lectures: Dr. Craig. The substance of this course was given a second time in eleven lectures addressed to Civil and Military Engineers.*

Theory of the Telescope (15). *Four lectures, to astronomers and mathematicians, delivered in Washington: Dr. Hastings.*

Laboratory Work for special Students (7). *Five times weekly, through the year: Prof. Rowland.*

Laboratory Work: Saturday Class for advanced Students (9). *Once weekly, through the year: Dr. Hastings.*

Laboratory Work: Saturday Class in General Physics (7). *Once weekly, through the year: Dr. Hastings.*

Reading and Discussion of current Physical Journals (7). *Once weekly, through the year.*

The Fellows and advanced students have also been engaged in researches under the direction of Prof. Rowland: In determination of the diamagnetic constants of bismuth and calc spar; on the distribution of heat in the spectrum of a platinum wire heated to various known temperatures; on the law of radiation at high temperatures; on the ratio of the electromagnetic to the electrostatic units of electricity; on various problems in hydrodynamics, etc.

Chemistry. (39 Students.)

General Chemistry (39). *Four lectures by Prof. Remsen, and two examinations by Dr. Morse, weekly, first half year*

General Chemistry (continued) (18). *Four lectures and two examinations weekly, second half year: Dr. Morse.*

Laboratory Work (30). *Four to eight hours daily, through the year: Prof. Remsen and Dr. Morse.*

Organic Chemistry (14). *Four lectures weekly, second half year: Prof. Remsen.*

Analytical Chemistry (11). *Once weekly, through the year: Dr. Morse.*

History of Chemistry (15). *Twelve lectures: Prof. Remsen.*

Reading and Discussion of current Chemical Journals (7). *Twice weekly, through the year.*

The Fellows and advanced students have also been engaged daily in the laboratory in following out various investigations, mostly under the direction of Prof. Remsen. The principal of these are: On the oxidation of cymenesulphamide; on the oxidation of orthotoluene sulphamide; on the oxidation of nitroxylenes; on the use of various oxidizing agents on the oxy-acids; comparison of sulpho-acids prepared by different methods. The results of the investigations referred to have either already been printed, or will soon be published in full in the chemical journals.

Biology. (26 Students.)

General Biology (13). *Twenty lectures, with practical study in laboratory: Prof. Martin.*

Animal Physiology: Advanced Course (8). *Twenty lectures, with demonstrations: Prof. Martin.*

Animal Physiology: Elementary Course (13). *Fifty-five lectures, with practical work, demonstrations, and weekly examinations: Prof. Martin.—Examiners, Prof. Donaldson and Prof. Latimer.*

Animal Morphology: Advanced Course (3). *Fifty lectures, with laboratory work: Dr. Brooks.*

Animal Morphology: Elementary Course (6). *Sixty lectures, with laboratory work and weekly examinations: Dr. Brooks.—Examiner, Prof. Martin.*

Embryology (7). *Twelve lectures, with laboratory work: Dr. Brooks.*

Vegetable Morphology (9). *Twenty-four lectures, with laboratory work: Prof. Farlow.*

Laboratory Instruction (26). *Daily through the year: Prof. Martin and Dr. Brooks.*

Demonstrations in Animal Physiology to Medical Students (25). *Twenty lectures, illustrated with experiments: Prof. Martin.*

Practical instruction in Animal Histology to Medical Students (12). *Sixteen lectures, with laboratory work: Mr. Sewall.*

Teachers' Class in Zoölogy (15). *Fifteen lectures, with laboratory work, three hours a week for fifteen weeks: Dr. Brooks.*

General Biology (66). *Twenty public lectures: Prof. Martin.*

Various Botanical Topics (89). *Six public lectures: Prof. Farlow.*

During the year investigations have been carried on by advanced students, under the direction of Professors Martin and Brooks, in various subjects as follows:—Function of certain respiratory muscles; the respiratory functions of certain nerves; the phenomena of muscular contraction; the effect of increased temperature on the respiratory rhythm; the development of Amblystoma; the locomotion of Gasteropods, etc. The results of several of these investigations have been published.

During the summer of 1878 the Chesapeake Zoölogical Laboratory, for the study of forms of marine life, was conducted for eight weeks by Dr Brooks, at Fort Wool, Va., with an attendance of ten students. It was reopened at Crisfield, Md., June 25th, 1879, and continued there and at Fort Wool until September 15th. A party of twelve investigators availed themselves of its facilities.

Greek. (40 Students.)

Lucian (12). *Once a week, through the year: Prof. Gildersleeve.*

Aristophanes, *Frogs* (14). *Thirteen meetings: Prof. Gildersleeve.*

Syntax of Moods and Tenses (6). *Once a week, from November to the end of the year: Prof. Gildersleeve.*

Practical exercises in translating Greek into English and English into Greek at dictation. *Twice a week, from April to the end of the year: Prof. Gildersleeve.*

Greek Seminary (13). *Once a week, through the year: Prof. Gildersleeve.*

Thucydides (14). *Four times weekly, first half year: Prof. Morris.—Examiner, Mr. Savage.*

Euripides, *Ion*, *Bacchae* (7). *Four times weekly, second half year: Prof. Morris.—Examiner, Prof. Gildersleeve.*
Plato, *Phaedo* (7). *Five times weekly, first half year: Prof. Cross.—Examiner, Dr. E. G. Sihler.*
Plato, *Protagoras* (2). *Four times weekly, for three months: Dr. E. G. Sihler.*
Aeschylus, *Prometheus* (4). *Five times weekly, second half year: Prof. Cross.—Examiner, Prof. Gildersleeve.*
Xenophon, *Anabasis* (3). *Four times weekly, second half year: Prof. Cross.—Examiner, Mr. Bevier.*
New Testament Greek (3). *Once weekly, second half year: Prof. Cross.*
Cyprus and Mycenae (81). *Eight public lectures: Mr. Savage.*
New Testament (12). *Ten public lectures: Prof. Cross.*

Students have privately read and been examined in:

Plato, *Apology*, *Crito* (1). *Examiner, Mr. Harding.*
Herodotus, *lib. v-ix.* (1). *Examiner, Prof. Morris.*
Euripides, *Phoen.*, *Alc.*, *Hippol.* (1). *Examiner, Prof. Gildersleeve.*
Euripides, *Medea* (2). *Examiner, Prof. Gildersleeve.*
Aeschines, *in Ctesiphont.* (1). *Examiner, Prof. Gildersleeve.*
Demosthenes, *de Corona* (1). *Examiner, Prof. Gildersleeve.*
Demosthenes, *Olynthiacs* (3). *Examiner, Prof. Morris.*
Demosthenes, *in Lacritum* (3). *Examiner, Prof. Morris.*
Sophocles, *Five Plays* (1). *Examiner, Prof. Everett.*
Homer, *Iliad*, *i-ix.* (1). *Examiner, Prof. Gildersleeve.*

The exercises of the Greek Seminary have consisted in analysis, exegesis and criticism of selected tracts of Lucian, and in the prosecution of researches into the language of Lucian and the life of the second century, such as Lucian's relation to Herodotus, the Ionism of the *Dea Syria* and the *De Astrologia*, the use of the optative in Lucian, Lucian and Diogenes Laertius, traditions as to the oriental origin of Greek philosophy, the worship of the Syrian Goddess, Lucian's attitude toward religion, and Lucian as a student of art. Some of the more elaborate papers were transferred to the Johns Hopkins Philological Association. The Seminary was conducted by Prof. Gildersleeve.

Latin. (27 Students.)

Juvenal (10). *Four times weekly, first half year: Prof. Morris.—Examiner, Prof. Maupin. Five times weekly, second half year: Prof. Cross.—Examiner, Prof. Morris.*
Persius (8). *Four times weekly, first half year: Prof. Morris.—Examiner, Prof. Gildersleeve.*
Cicero, *Brutus* (6). *Four times weekly, second half year: Prof. Morris. Examiner, Prof. Maupin.*
Cicero, *Orator* (6). *Four times weekly, second half year: Prof. Morris. Examiner, Prof. Maupin.*
Tacitus, *Annals* (9). *Five times weekly, second half year: Prof. Cross.—Examiner, Prof. Maupin.*
Livy (13). *Five times weekly, first half year: Prof. Cross.—Examiner, Prof. Maupin.*

Students have privately read and been examined in

Plautus, *Captivi* (1). *Examiner, Prof. Maupin.*
Terence, *Phormio* (2). *Examiner, Prof. Maupin.*
Terence, *Hautontim* (1). *Examiner, Prof. Maupin.*

Terence, *Andria* (3). *Examiner, Prof. Maupin.*
Tacitus, *Germania, Agricola* (5). *Examiner, Prof. Maupin.*
Tacitus, *Hist. lib. i.* (4). *Examiner, Prof. Maupin.*
Cicero, *Select Letters* (1). *Examiner, Prof. Morris.*
Cicero, *de Officiis* (1). *Examiner, Prof. Maupin.*
Horace, *Satires* (1). *Examiner, Prof. Everett.*
Horace, *Odes, Epodes* (6). *Examiner, Prof. Everett.*
Virgil, *Aeneid* (5). *Examiner, Prof. Everett.*

German. (55 Students.) *Prof. Brandt.—Examiners, Prof. Elliott and Prof. Raddatz.*

Major Course (16). *Five times weekly, first half year.*
Minor Course (17). *Five times weekly, through the year.*
Goethe, *Faust* (15). *Once weekly, through the year.*
Lessing, *Laokoon* (13). *Once weekly, second half year.*
Middle High German [Nibelungenlied]. (7). *Two lectures and two recitations weekly, second half year.*
Scientific German (14). *Once weekly, second half year.*
German Literature (17). *Six lectures.*

French. (15 Students.) *Prof. Rabillon.—Examiner, Prof. Elliott.*

Major Course (10). *Twice weekly, through the year.*
Minor Course (5). *Twice weekly, through the year.*
Special Class. *Once weekly, second half year.*
French Romantic Literature (35). *Eleven public lectures.*

Romance Languages. (3 Students.) *Prof. Elliott.*

Old French [Serments de Strassbourg; Cantilène de Sainte Eulalie; La Passion de Christ; Vie de Saint Léger; Vie de Saint Alexis]. (3). *Five times weekly, through the year.*
Provençal [Poëme sur Boëce; extracts from writings of Guillaume IX. Comte de Poitiers; the Roman de Girart de Rossilho]. (2). *Once weekly, through the year.*
Scientific Grammar (3). *Once weekly, through the year.*
Italian [Dante, *Purgatorio*]. (2). *Twice weekly, through the year.*
Geographical Distribution of the Old French Dialects (3). *Lectures weekly, through the year.*
Dante, *Divina Commedia* (152). *Ten public lectures.*

Sanskrit. (4 Students.) *Prof. Lanman.*

Hymns of the Rig Veda (1). *Thrice weekly, through the year.*
Kathâsaritsâgara, and Yâjñavalkya (1). *Twice weekly, first half year.*
Elementary Sanskrit [Nala, Hitopadeça, Manu]. (3.) *Twice weekly, through the year.*

Shemitic. (9 Students.) *Prof. Murray.*

Arabic (2). *Twice weekly, first half year.*
Syriac (4). *Thrice weekly, first half year.*
Biblical Hebrew (6). *Twice weekly, first half year.*
Shemitic Literature (9). *Twelve lectures.*
Hebrew: Elementary Course (3). *Thrice weekly, through the year: Mr. Bloomfield.*
Poetical Books of Old Testament (41). *Nine public lectures: Prof. Murray.*

Logic. (6 Students.) *Mr. Marquand.*

Bacon's Novum Organum (2). *Twice weekly, second half year.*
Inductive and Deductive Logic (5). *Four times weekly, second half year.—Examiner, Prof. C. D. Morris.*
Elementary Course (2). *Thrice weekly, first half year.*

Ethics. (6 Students.)

History of English Ethics (4). *Once weekly, second half year: Mr. Marquand.*
Reading Class (4). *Twice weekly, December and January: Mr. Marquand.—Examiner, Prof. G. S. Morris.*
Topics Historical and Practical in Ethics (123). *Ten public lectures: Prof. G. S. Morris.*

History. (25 Students.)

Seminary of American History (10). *Once weekly, through the year: Dr. Scott.*
European History during the Middle Ages (14). *Four times weekly, first half year: Dr. Adams.—Examiner, Dr. Scott.*
German History (9). *Twice weekly for two months: Dr. Adams.*
German Empire (258). *Ten public lectures: Prof. Von Holst.*
Beginnings of Church and State (83). *Ten public lectures: Dr. Adams.*
History of Greece in Fifth Century B. C. (39). *Ten public lectures: Dr. E. G. Sihler.*
Thirty Years War (192). *Twenty public lectures: Prof. Diman.*

Political Science. (15 Students.)

Seminary of English Constitutional Law (15). *Six meetings; Prof. Cooley.*
Political Economy (15). *Four times weekly, two months: Dr. Adams.*
Evils in Local Government (87). *Six public lectures: Prof. Cooley.*

C.

List of Apparatus for Scientific Researches involving Accurate Measurements in the Physical Laboratory.

The list does not include apparatus for demonstration.

Republished, with additions, from Harvard University Library Bulletin, No. 12, 1879.

ACOUSTICS.

All the ordinary apparatus by Koenig of Paris, including Helmholtz's double siren, Lissajou's vibrating microscope, Hastings' pendulum comparator, &c.

OPTICS.

1. *Meyerstein Spectrometer*—large model. The circle is of 16 centimeters radius, divided on silver to 6′ and reading by two microscopes to 2″. The probable and periodic errors of graduation have been investigated, and are given in the American Journal of Science, vol. xv. p. 270. Having a common axis with the large circle is a table rotating independently, 6.5 centimeters radius, graduated on a silver limb and by two verniers to single minutes. The massive stand has a joint by which the circle may be brought into a vertical plane. Aperture of telescope and collimator 4.0 centimeters, focal length 84 centimeters, powers from 13 upward. A smaller telescope 2.0 centimeters aperture, 18.0 centimeters focal length, power 7, may be placed on a third support rigidly connected with the microscope bearers. The accessories of this instrument are:—

(*a*). Two telescopes with Nicol prisms before objectives: longer diagonals of prisms, 2.0 centimeters; length of telescopes, 20.0 centimeters; power, 3; position angles of prisms read by circles of 3.5 centimeters radius to minutes of arc.

(*b*). Babinet's compensator with wedge of 3 centimeters available length.

(*c*). High power collimating ocular.

(*d*). Low power collimating ocular.

(*e*). Three micrometer eye-pieces.

2. *Spectrometer*, by Schmidt and Haensch. The circle has a silver limb 16 centimeters radius, divided to 6′ and read by microscopes to 2″. Table in centre has a graduation 6.0 centimeters radius, reading by verniers to 1′. Aperture of objectives of telescope and collimator, 3.9 centimeters; focal length, 35.0 centimeters; power, 13. The angle between lines of collimation of telescope and the collimator may be read by small circle to single degrees.

3. *Steinheil's Spectroscope.* The clear aperture of train, including two 60° prisms, is 4.0 centimeters. Focal length of collimator and telescope 32.5 centimeters, powers, 8, 12, *etc.* Photographic scale.

4. *Silbermann's Heliostat*, etc. This instrument, by Duboscq, has two mirrors 18.0 centimeters by 9.0 centimeters, one silver under glass and the other silver. Also, *porte-lumière.*

5. *Heliostat*, with perfect plane mirror 16.8 c. m. diameter. Designed by Rowland and made by Schneider.

6. *Jamin's Interferential Refractometer*, with tubes 100 centimeters long, for the study of refraction in gases and a glass trough 20 centimeters long for liquids, by Duboscq.

7. Complete apparatus for the study of phenomena of interference, by Duboscq.

8. *Photographic Apparatus.* Objective 6.1 centimeters aperture, and about 40 centimeters focal length for plates; 10 × 12 inches, by Steinheil. Dark room, collection of chemicals and everything necessary for experiments on the subject.

9. *Becquerel's Phosphoroscope*, by Duboscq.

10. *Polarizing Apparatus*, from Steeg; also from Duboscq.

11. Apparatus for producing monochromatic light of any color. Designed by Hastings and made by Schneider.

12. *Prisms, gratings*, etc.

a. Hollow prism from Meyerstein; aperture, 6.1 × 5.2 centimeters.

b. Hollow prism from Steinheil; aperture, 2.2 centimeters.

c. Thallium glass prism from Steinheil; aperture, 4.8 centimeters.

d. Two flint glass prisms from Steinheil; aperture, 4.7 centimeters.

e. Crown glass prisms from Steinheil; aperture, 4.8 centimeters.
f. Two quartz prisms from Steeg; faces, 3.4 × 3.0 centimeters.
g. Iceland spar prism; faces, 2.6 × 2.2 centimeters, by Steeg.
h. Two rocksalt prisms; faces, 5.0 × 4.0 centimeters, by Steeg. Also rocksalt lens.
i. Large Nicol prism, largest diagonal 6.5 centimeters. Also a number of smaller ones.
j. Gratings on speculum metal 4.3 × 3.9 centimeters with 8648 lines to the inch and 4.4 × 4.4 centimeters with 17396 lines to the inch, and a smaller glass grating with 8648 lines to the inch, all by Chapman with Rutherfurd's engine.
Kirchoff's, Angstrom's, and Rutherfurd's maps of the solar spectrum.
k. Old telescope by Dollond. Objective about 4 in. diameter and 6 ft. focal length.

ELECTRICITY AND MAGNETISM.

The distinguishing feature of the apparatus for these subjects is its accuracy and the determination of the constants in absolute measure. The collection is *unique* in this respect.

13. *Rowland's Absolute Electrometer* for potentials represented by sparks of about 0.1 to 1 inch. Designed on Sir Wm. Thomson's guard-ring principle and constructed by Edelmann of Munich. Guard-ring 33.5 centimeters diameter, and can be separated about 7 centimeters, the distance being read by vernier to 0.01 centimeter. Movable disc 10 centimeters diameter, and *firmly* attached to arm of a balance sensitive to 1 mgr. Balance moves only .01 centimeter, and means of two distances of the discs are taken, the one to move it to upper and the other to lower stop. Weights of from 1 to 5 grammes ordinarily used. *Discs ground and polished to mirror surface after nickel plating.*

14. *Rowland's Electrostatic Standard Condenser.* Constructed by Grunow of New York. One sphere within the other *nickel plated and ground to mirror surface*, with extra ball for interior. Balls, 7 and 8 inches diameter. Hollow sphere, 10 inches diameter. Apparatus for centering. Radii determined by loss of weight in water. Can be charged and discharged any number of times at the rate of three per second, by means of fine wires which pass in momentarily from outside and so do not change the capacity much. Any condenser can be compared with it by means of an electrometer.

15. *Thomson's Quadrant Electrometer*, by White of Glasgow, with Thomson's key.

16. *Condenser* $\frac{1}{3}$ microfarad by Elliott.

17. *Commutators* for high (say 1 inch spark) as well as low tension.

18. *Rowland's Galvanometer* for the absolute measurement of discharges of high tension. Constructed by Rowland and Schneider. Coils wound with paper between, and boiled in parafine *in vacuo* at 100° C. to be thoroughly dry. Needle shielded from electrostatic action, and deflection read by mirror and scale. Number of coils about 11000. Constant on the cm. gr. second system 19091. = G of Maxwell as determined by comparison with galvanometer described in American Journal of Science, vol. xv., p. 334. See no. 19 below.

19. *Rowland's absolute Galvanometer* for the measure of quite weak currents Constant 1833.2. See American Journal of Science, vol. xv., p. 334. Constant very accurately known. 1790 turns. Can be used as sine galvanometer or with mirror and scale. Horizontal circle reads to

1′, but is readily estimated to 30″. Telescope and bar for determining horizontal intensity in exact position of instrument.

20. *Rowland's Tangent Galvanometer*, brass circle 50 centimeters diameter. Circle graduated to 15′ and 20 centimeters diameter. From 1 to 243 turns can be used, the constant of each set being known with great accuracy. Made by Meyerstein, but altered and wound and coils measured by Rowland.

21. *Two Thomson's Galvanometers* of high and low resistance, the first differential with coils around both needles and set of shunts. Made by Elliott of London.

22. *Two Nobili Astatic Galvanometers* by Elliott, and one by Salleron.

23. *Wiedemann Galvanometer* with two sets of coils and two kinds of needles. Reading by mirror and scale.

24. *Galvanometer* with large wire for experiments on the damping effect of the coils on the needle, and for determining resistances in absolute measure. Designed by Rowland and made by Schneider.

25. *Tangent Galvanometer*, wooden circle, with variety of coils of known constant.

26. *Mirror Galvanometer.*

27. *Rowland's wooden circle*, 84 centimeters diameter, carefully laid up out of maple wood, and containing several grooves on the edge to contain single wires. It is used to surround a galvanometer when, by the aid of the electrodynamometer, the horizonal intensity can be measured at any instant. Extremely useful.

28. *Electrodynamometer* of form given in Maxwell's Electricity, vol. ii, p. 330. Outer circles about 27.5 centimeters diameter with 240 windings on each side. Constant, G, of outer coils 78.371 on cm. gm. second system. Inner coils about 5.5 centimeters diameter with 63 coils in each. Moment of inertia of suspended coil accurately known Constant calculated and also determined by comparison with a tangent galvanometer made of the circle described above. Made (partly) by Gurley of Troy, and circles wound and measured by Rowland.

29. *Electrodynamometer*, Quincke's form for weak currents. Made by Edelmann of Munich.

30. *Standards of Resistance* mounted so that they can be placed in water. 1 and 10 ohms by Elliott; 10, 100, and 1,000 ohms by Warden, Muirhead, and Clark of London; also mounted in another style 1, 10, and 100 Siemens' units, by Siemens and Halske of Berlin. Also three copies of coil whose absolute resistance was determined by Rowland as 34.719 *earthquad.* $\div$ *sec.*

31. *Resistance coils* in boxes 1 to 10,000 and 10,000 to 100,000 ohms by Elliott, and 1 to 10,000 Siemens' units by Edelmann.

32 *Rowland's Resistance Comparator.* Ten coils of 10 ohms each, arranged so that they can be joined in series or abreast thus making 1, 10, and 100 ohms besides intermediate ones. Made by Schneider and adjusted by Rowland.

33. *Two bridges* of Jenkins' form for the accurate comparison of equal resistances, and also a Wheatstone bridge, having wire of platinum-iridium alloy one meter long, by Elliott.

34. *Magneto-electric Machine* for 1,200 candles, by Siemens Brothers, London, with engine to drive it, and both Siemens' and Foucault's lamps. Also battery of 60 large bichromate cells.

35. *Ruhmkorff coil*, spark 15 or 20 centimeters, by Ruhmkorff of Paris.

36. *Rowland's Earth inductor* with *brass* circle. 30 centimeters diameter, wound and measured by Rowland. Made by Meyerstein of Göttingen.

37. *Ruhmkorff's Apparatus* for diamagnetism. Made by Ruhmkorff of Paris.

38. *Electric Clocks* beating seconds from regulator.

39. *Rowland's Standard of Electromagnetic Induction.* Three coils on brass cylinders which can be placed accurately on top of each other. See American Journal of Science, Vol. XV. Mutual potential of coils with unit current 3775500., 2561974., 2051320, *etc.*, on the cm. grm. second system.

40. *Telescopes, Scales, and Mirrors.* Silvered brass millimeter scale by Brown and Sharp. Mounted telescope by Steinheil, objective 4.0 centimeters diameter, with three oculars, giving powers of 20, 40, and 80. Unmounted telescope by Steinheil, objective 2.7 centimeters diameter, and 3 oculars.

Mounted telescope and paper scale by Meyerstein: objective, 2.7 centimeters diameter.

41. Thin mirrors and plain parallel glasses by Steinheil. The mirrors give a *perfect image of the highest magnifying power.*

Thomson's Replenisher on large scale for use with electrometer, Holtz and friction machines, Leyden jar batteries, Geissler tubes, &c.

HEAT.

42. *Rowland's Instrument for comparing the mercurial with the air Thermometer* between 0 and 100° C. Constructed by Schneider. Readings seldom differ more than 0.02° or 0.03° C. at any one point, especially up to 40° C., and a change is contemplated which will much improve it.

43. *Rowland's Instrument for comparing Thermometers* from 0° to about 300° C. Constructed by Schneider. Accurate to about 0.1° C.

44. *Regnault's Air Thermometer*, Golaz, Paris.

45. *Jolly's Air Thermometer*, by Berberich, Praeparator, Phys. Inst., Univ. of Munich.

46. *Regnault's Apparatus for Expansion of Gases* both at constant pressure and constant volume, also Regnault's form of Rudberg's apparatus, Golaz, Paris.

47. *Regnault's Apparatus for Tension of Vapors*, including: *a.* The boiler; *b.* The reservoir for compressed air; *c.* A rotary pump for compressing gases; *d.* Mercurial manometer. Maker, Golaz, Paris.

48. *Regnault's Apparatus for specific Heat* of solids, Golaz, Paris.

49. *Regnault's Hygrometer with Aspirator*, Golaz, Paris.

50. *Thermometers*, about 30 or 40, principally by Baudin, Paris, and Geissler, of Bonn. Many of these have been compared with the air thermometer as well as with standards by Fastré, Casella, or from Kew. The thermometers up to 40° C. undoubtedly represent the air thermometer more accurately than any so far constructed, and are supposed to agree with it to about 0.01° C. They have been compared with it eight times during about one year or more. The error in calorimetric investigations from using uncompared thermometers *may* amount to two per cent.

51. *Rowland's Apparatus for determining Change of specific Heat of Liquids* with temperature. Constructed by Schneider.

52. *Dulong's Apparatus for the Heat of Combustion*, Salleron, Paris.

53. *Melloni's Apparatus* for radiant energy, Salleron, Paris.

54. *Two Instruments for the Calibration* of mercurial thermometers, one by Golaz and the other by Salleron.

55. *Rowland's Apparatus for determining the mechanical Equivalent of Heat*, or for investigating the specific heat of liquids and their change with rise of temperature.

This instrument was constructed by the aid of funds contributed by the Rumford committee of the American Academy of Arts and Sciences, but the instrument will remain for the present at Baltimore. It was constructed by Schneider. It is run by a petroleum engine, No. 67 below.

*** To be constructed soon :—

Apparatus for compressing gases to 1000 atmospheres.

Apparatus for *accurately* determining the form of the adiabatic curve of gases and vapors *at any temperature up to about* 100° C.

Miscellaneous.

56. *Comparator*, by Meyerstein, for bars 1 meter long. Microscopes cannot be set nearer than 10 centimeters. One division of head of micrometer screws is about $\frac{1}{100}$ millimeter.

57. *Microscope Comparator*, designed by Rowland after Rogers' plan, and made by Grunow.

58. *Dividing Engine*, by Perreaux. Free motion about 55 centimeters. Screw, $\frac{1}{2}$ millimeter thread. Head divided into 250 parts. 501 divisions of head gives 1 millimeter almost exactly. Subsidiary screw at right-angles to the other.

59. *Air Pumps.* Rotary and common, by Ritchie, of Boston ; mercury, on Jolly's plan, by Berberich, of Munich.

60. *Rotary Pump* for compressing gases to 15 atmospheres, Golaz, Paris.

61. *Three Mercury Guages ;* one about 25 meters high, and measuring pressures up to about 33 atmospheres ; one movable and measuring pressure from 1 to 4 atmospheres ; and one measuring from 0 to 1 atmosphere.

62. *Barometer*, by James Green of New York, with very large tube.

63. *Two Cathetometers*, one by Meyerstein, and the other by Salleron.

64. *Standard Meters*, compared at Washington.

65. *Balances and Weights.* One balance weighing to 5 kilo. and accurate to about 1 mg. with weights from 5 kilo. to 1 mg. One weighing to 200 grms. accurate to about 0.1 mg. with weights from 100 gr. to 1 mg. These are by Schickert of Dresden. One heavy balance weighing to about 25 kilo. and accurate to about 0.1 grm. by Schneider.

Standard glass kilogramme on Jolly's plan, and compared with Berlin standard. From Berberich in Munich.

The first balance mentioned is mounted on top of a case, so that globes for weighing gases can be suspended beneath it.

66. *Clock-work* with Foucault's regulator for running small apparatus at a regular velocity.

67. *Petroleum Engine* of three-horse power. It is capable of giving a large amount of compressed air at more than 100 pounds to the square inch pressure, and might be used for repeating Thomson's and Joule's experiments, or any others on the flow of gases.

68. *Two Spherometers*, large by Meyerstein, and small by Salleron.

69. Several extra micrometer eye-pieces.

70. *Apparatus for Researches on the Flow of Liquids.* Greatest available head about 1.4 meters.

71. *Revolving mirror* capable of 250 revolutions per second. Mirror of glass silvered on both sides and 4.7 cm. diameter. Driving power, compressed air from a Root blower. Designed by Rowland and made by Schneider.

72. *Metallic Manometer* for very minute differences of pressure, from Edelmann of Munich.

*** Nos. 19, 25, 26, and 28 and the silvered scale of No. 40 belong to Professor Rowland, but are used in the laboratory.

List of the More Important Physiological Apparatus in the Biological Laboratory.

1. Eighteen microscopes, by Zeiss of Jena; magnifying 60, 110, 220 and 400 diameters.

2. One complete monocular microscope, by the same maker, with a set of oculars and objectives magnifying from 10 to 1700 diameters. Also, a microspectroscope and polarising apparatus, camera lucida, condenser, &c.

3. Two Stricker's "hot stages."

4 Two ditto, with Shäfer's self-regulating apparatus for maintaining a constant temperature.

5. Two Zeiss and six other microtomes.

6. Two Zeiss dissecting microscopes.

7. Four DuBois-Raymond induction coils.

8. Dewsmith's levers. Made of Aluminium and delicately poised; working on steel points in agate cups. The two levers work vertically over one another in the same plane and are available for recording very feeble movements.

9. Kronecker's capillary contact apparatus, much improved, giving any desired number of contacts from 1 to 50 per second.

10. Bernstein's "*acustische unterbrecher*," somewhat modified.

11. Resistance coil 1-10 to 100 ohms. Elliott, London.

12. Reochord and Wheatstone's bridge. Elliott, London.

13. Seconds clock, with electric connections for working chronographs, &c.

14. Thomson's reflecting galvanometer and shunt. Resistance 6601 ohms at 16 5° C.

15. Thomson's reflecting galvanometer. Resistance 0.4347 ohm at 23° C.

16. Metronome, with electrical attachment, giving contacts from 6 to 2)0 times in a minute.

17. Six small thermopiles.

18. Konig's recording tuning forks, three pairs, vibrating respectively 50. 100 and 200 times in a second

19. "Signal," of Deprez, working up to 250 vibrations per second.

20. Marey's chronograph, working up to 100 vibrations per second.

21. Martin's self-feeding chronograph pens (4).

22. Helmholtz's electromotor. Zimmerman, Heidelberg.

23. Bernstein's rheotom. Zimmerman, Heidelberg.

24. Pendulum myographion, modified from Fick's: available for the measurement and analysis of rapid movements. The instrument consists essentially of a pendulum carrying a glass plate at the bottom, swinging on friction rollers, and corrected for the latitude of Baltimore, so as to swing in one second. Behind the pendulum is a divided arc, and the amplitude of the swing can be varied from a few inches to four feet. In use, an electro-magnet is moved along the divided circle, and then—the current being closed through it—the pendulum on being raised is held by it. On the other side is a catch, also movable along the arc. By turning a key at the side, the current in the electro-magnet is broken, and the pendulum swings across, and is held by the catch on the other side. During its transit, the movement to be analyzed is inscribed on the glass plate, which is previously smoked. Designed by A. G. Dewsmith, Esq., Trinity College, Cambridge, England. Made by Elliott, London.

25. Brunton's double myograph.
26. Ludwig's kymographion, (2), one with an improved regulator. Fulcher, Cambridge, Eng.
27. Kymographion, modification of the above, giving both slower and more rapid movement. Warden, Muirhead & Clark, London.
28. Ludwig's stromuhr.
29. Mosso's plethysmograph.
30. Marey's sphygmograph.
31. Injecting apparatus, with water pressure.
32. Czermak's rabbit holders (2).
33. Bernard's dog holders (2).
34. Spectroscope, by Browning, London, (one prism.)
35. Wild's polaristrobometer.
36. Rotating cylinder, run by clockwork. Hawksley, London.
37. " " " " Baltzar, Leipsic.
38. " " " " Fulcher, Cambridge.
39. Marey's tambours (3)
40. Kronecker's digestion apparatus.
41. Seconds pendulum, for breaking electric currents.
42. Roy's apparatus for measuring changes in arterial pressure. (Jour. Physiol , Vol. II, p. 68.)
43. Warm chamber with self-regulating apparatus for maintaining a constant temperature.

Apparatus available only for teaching purposes or demonstration is excluded from this list; as also the ordinary outfit of every laboratory—as balances, glass ware, thermometers, filter pumps, electric batteries and keys, electrodes, surgical instruments, moist chambers, muscle levers, &c., &c.

Chemical Laboratory.

The Chemical Laboratory is a new building well arranged and equipped. It has the usual collection of balances; platinum and silver utensils; a spectroscope; a polarizing apparatus, made by Herman and Pfister; a goniometer, made by Fuess of Berlin, such as is described in Groth's Physikalische Krystallographie. The circle of the goniometer is of silver, and is divided to $\frac{1}{4}°$; it has two verniers which read to 30″, and angles may be readily estimated to 10″. It has two telescopes, one to focus the image of a slit, and the second, to observe the crystals and image of the slit.

D.

Report of Chesapeake Zoölogical Laboratory.

Summer of 1879.

To the President of the Johns Hopkins University:

Dear Sir: In accordance with your request I have the honor to submit the following report of the Second Session of the Chesapeake Zoölogical Laboratory.

ORGANIZATION.

In order to present an opportunity for studying the oyster beds of the Bay, and thus secure the coöperation of Maj. Ferguson, Assistant U. S. Fish Commissioner, I determined to open the laboratory at Crisfield, a point which is unfavorable in most other respects. The laboratory was accordingly opened at Crisfield on the 25th of June in three of the barges of the Maryland Fish Commission.

I stated in the preliminary announcement that the laboratory would be moved to some more desirable locality farther down the Bay, about July 10th, but the transportation of the barges was attended with so much expense that I was not able to move them to the second station, and we occupied them at Crisfield until August 8th. During part of this time Maj. Ferguson's steam yacht, the Lookout, which he had fitted up with steam dredging apparatus for the purpose, was with us, and rendered valuable help in dredging and collecting. Through Maj. Ferguson's influence we also had the use of a small steam launch which was detailed for the purpose from the U. S. Navy.

Early in August the musquitoes became so numerous as to render the the barges uninhabitable, and as I was not able to move them, we transferred our outfit to our old quarters at Fort Wool, which had again been placed at our service by Maj. Gen. Q. A. Gillmore, U. S. A.

The party remained at Fort Wool until September 15th, thus extending the second session of the laboratory over eleven weeks.

The following is a list of the members of the party.

MEMBERS OF THE STAFF.

W. K. BROOKS, Ph. D., *Associate in Biology.*
In charge of Laboratory.
S. F. CLARKE, Ph. D., *Assistant in Biological Laboratory.*
Assistant in Laboratory.
B. W. BARTON, M. D., *Baltimore.*
EMIL BESSELS, M. D., Ph. D., *Smithsonian Institution.*
E. A. BIRGE, Ph. D., *Prof. of Zoölogy, Univ. of Wisconsin.*
H. C. EVARTS, M. D., *Acad. of Science, Philadelphia.*
E. A. NUNN, M. A., *Prof. of Biology, Wellesley College.*
H. J. RICE, M. A., *Cazenovia, N. Y.*
E. B. WILSON, Ph. B., *Johns Hopkins University.*
K. MITSUKURI, Ph. B., *Yale College.*
AUGUST SCHMIDT, M. A., *Baltimore.*
C. SIHLER, M. D., *Johns Hopkins University.*

SCIENTIFIC INVESTIGATIONS.

As most of the members of the party were trained investigators the amount of work which we were able to accomplish was very satisfactory.

Some of it is now in press, and there are a number of completed papers ready for publication, and I hope that means for this purpose will be found during the year.

It is impossible to give a short statement of the results of the prolonged study of a technical scientific problem, and I must refer to future publications for information regarding the work which was accomplished by our party. The following is a list of those subjects in regard to which our labors were most fruitful in new information:

Dr. Clarke devoted most of the season to the collection and study of Hydroids, and he finds that most of the species which occur in the Bay are new to science. Interesting hydroids were found in great abundance, but the season proved to be too short for the thorough study of all the forms which were collected, though in addition to the description of a number of new species, Dr. Clarke was able to make important observations upon their structure, manner of growth, and other points of interest.

Prof. Birge succeeded in making a very complete series of observations upon the larval stages of two genera of crabs. He traced these from the egg to the adult form, and secured a complete series of drawings showing each appendage at each stage of development.

The interesting field upon which Prof. Birge has thus made a beginning, is one in which the Chesapeake Bay furnishes unrivalled facilities, and a number of workers could easily find here material for years of study. I hope that future years will show important results from the investigation of the development of the crustacea of the bay, for this is undoubtedly the subject upon which the laboratory may be expected to yield the most abundant and valuable contributions to science.

Prof. Birge, together with myself, made several attempts to make a careful study of the development of the edible crab, but stormy weather prevented us from completing our work, and we must wait for future opportunities to complete the observations which we were able to make this season.

Prof. Nunn studied the development of the Ctenophorae, especially Nemiopsis, and obtained interesting results regarding the changes which accompany the fertilization of the egg.

Besides working upon other subjects, Mr. Wilson carefully revised the change of the Actinotrocha into Phoronis. He succeeded in raising the Phoronis from the Actinotrocha, and in keeping it until all the adult characteristics were acquired, and he not only verified the results of previous writers, but also added many observations regarding the details of the process of transformation.

Most of my own time was spent in studying the development and artificial propagation of the oyster. I obtained information upon a number of obscure points in molluscan development, and I also reached very unexpected conclusions regarding the breeding habits of the American oyster. I have reason to believe that these investigations will prove to be of great economic importance.

I also succeeded in obtaining a very complete series of stages in the development of the Squid, and among other new points, I have detected the presence of a rudimentary velum in this group of Molluscs.

Owing to the uncertainties which attend work at the ocean, upon living animals, our unfinished investigations are much more numerous than those which were made sufficiently complete for publication, and the list given above does not, by any means, represent all our work.

While we made no attempt to find or to describe new species, a few new representations of groups of especial interest have been sent to specialists on these groups for examination, and illustrated descriptions of some of them will soon be published.

Yours very truly,

W. K. BROOKS.

E.

Titles of Papers Presented to the Scientific and Literary Associations, 1878-79.

JOHNS HOPKINS PHILOLOGICAL ASSOCIATION.

PRINCIPAL PAPERS.

On the Special Province of the American Philologian. Oct. 4, 1878. By B. L. GILDERSLEEVE

On the True Basis of Vowel-Classification. Nov. 1, 1878. By H. C. G. BRANDT.

On the Original Case-Form in Shemitic. Dec. 6, 1878. By T. C. MURRAY.

On the Bilingual Cypriote Inscription of Dali. Jan. 10, 1879. By A. D. SAVAGE.

On Ionic Forms in the Second Century, A. D. Feb. 7, 1879. By F. G. ALLINSON.

Lucian and Greek Philosophy. March 7, 1879. By E. G. SIHLER.

On the Words of Relationship in Indo-European. April 4, 1879. By M. BLOOMFIELD.

On the Relation of the Asinus of Lucian to the Metamorphoses of Apuleius. May 9, 1879. By C. D. MORRIS.

MINOR COMMUNICATIONS.

On Prof. Sauveur's "Natural Method" as used in the Normal School of Modern Languages. By L. RABILLON.

On Declined Words in Composition and some Results drawn from their Study. By M. BLOOMFIELD.

On Tentative Linguistic Forms and their Significance for a Question of Linguistic Philosophy. By C. R. LANMAN.

On Homer and Strabo. By E. G. SIHLER.

On the Introduction of Italian Literature—particularly that of Dante—into Hungary. By A. M. ELLIOTT.

On the Use of the Question in Lysias. By F. G. ALLINSON.

A Tabular Statement of the Cases of Agreement and Non-Agreement with Grimm's Law in the Words contained in the Gothic Version of St. Matthew's Gospel. By C. DAVIDSON, of Mitchellville, Iowa.

On the Coincidence of the Results of Grammatical Investigation with the Results of other Methods of Criticism, and on the Mutual Confirmation of the Results of Grammatical Criticism. By C. R. LANMAN.

On the Theory of Ross that Tacitus' History was written by Bracciolini. By C. D. MORRIS.

On Low-back-narrow-round Vowels as Pronounced by Foreigners. By H. C. G. BRANDT.

On the Etymologies of the Word *trouver*. By S. GARNER.

On the Latin Asseverative and Interrogative Particles. By M. WARREN, of the University of Bonn.

Attic Inscriptions of the Fifth Century B. C., referring to the Tribute of the Attic Confederation. By E. G. SIHLER.

On the Word "Copula" in Logic. By A. MARQUAND.

On Expressions for Time in Later Greek. By F. G. ALLINSON.

The average number of members present was about 20.

Historical and Political Science Association of the Johns Hopkins University.

Principal Papers.

The Stone Age. A Review of Recent Works on Prehistoric Archæology. By H. B. Adams.
A Study of German Social Democracy. By A. Marquand.
Primitive Aryan Mythology from the Standpoint of Indian Literature. By M. Bloomfield.
Methods of Historical Inquiry as Pursued at German Universities. By H. Von Holst.
Methods of Historical Instruction as Pursued at Brown University. By J. L. Diman.
Maryland's Ratification of the Federal Constitution. By A Scott.
The Problem for Political Economy in the United States. By H. C. Adams.

Minor Communications.

The Swiss Lake-Dwellings. By C. R. Lanman.
The Depopulation of Central Greece in the Post-Classical Period. By E. G. Sihler.
A Review of the Question, "Was Maryland a Roman Catholic Colony?" By H. B. Adams.
Recent Complications in the School System of New Haven. By D. C. Gilman.
Notes on Niebuhr's Life and Works. By E. G. Sihler.
Lieber's "Reminiscences of Niebuhr." By D. C. Gilman.
Animistic Religion an Excrescence, not a Germ, of Vedic Religion. By C. R. Lanman.
The Boundary Controversy between Maryland and Virginia. By E. Goodman.
The First Public Proposal of a Constitutional Convention for the United States. By A. Scott.
The Position of Socialism in the Historical Development of Political Economy. By H. C. Adams
Moral Insanity as a Cause of Crime. By C. W. Nichols.
Attic Colonization. By E. G. Sihler.

Scientific Association of the Johns Hopkins University.

Principal Papers.

The Work of the Chesapeake Biological School during the Summer of 1878. By H. Sewall.
Observations on the Light of the Corona during the last Solar Eclipse. By C. S. Hastings.
The Development of Lingula. By W. K. Brooks.
Some Recent Investigations in Chemistry. By I. Remsen.
A Problem of Isomerism. By F. Franklin.
A Method for the Preparation of Isopropyltoluol. By H. N. Morse.

Extract of a Letter from Professor Frankland, referring to the Experiments of Lockyer "on the Nature of the so-called Elements." By J. J. SYLVESTER.
The Effect of Changes of Interval of Stimulation on the Height of Tetanus. By H. SEWALL.
On Floating Magnets. By B. AYRES.
On Electric-Light Apparatus. By H. A. ROWLAND.
Toluolsulpho Acids and their Oxydation Products. By C. FAHLBERG.
The Motion of a Solid in a Mass of Frictionless, Incompressible Fluid. By T. CRAIG.
The Function of the Internal Intercostal Muscles. By E. M. HARTWELL.
Lockyer's Investigations in Relation to the so-called Elements. By C. S. HASTINGS.
An Apparatus for Gas Analysis. By A. V. E. YOUNG.
A New Determination of the Ratio of the Electro-Static and Electro-Magnetic Units. By E. H. HALL.
Degradation by Parasitism. By W. K. BROOKS.
Some Phenomena of Oxydation. By L. B. HALL.
Distribution of Heat in the Spectra of Various Substances. By W. W. JACQUES.
A Review of a Paper by Professor Sylvester "on a Method of Investigating Fluid Motion." By T. CRAIG.
A New Method for the Determination of the Dynamical Equivalent of Heat. By L. B. FLETCHER.
The Method of Locomotion in the Gasteropod Mollusks. By S. F. CLARKE.
The Influence of Increased Temperature on the Respiration of Animals. By C. SIHLER.
The Oxydation of Toluene-Disulphamide. By C. FAHLBERG.
A Brief Statement of the Work of the Year 1878-9 in the Chemical Laboratory. By I. REMSEN.

F.

List of Scientific Papers Published by Members of the University, 1876-79.

MATHEMATICS.

BY PROFESSOR SYLVESTER.

In the American Journal of Mathematics.

Application of the New Atomic Theory to the Graphical Representation of the Invariants and Covariants of Binary Quantics.
On Differentiants Expressed in Terms of the Differences of the Roots of their Parent Quantics.
Note on M. Hermite's Law of Reciprocity.
Completion of the Theory of Principal Forms.
Additional Illustrations of the Law of Reciprocity.

On the Principal Forms of the General Sextinvariant to a Quartic and Quartinvariant to a Sextic.

On the Probable Relation of the Skew Invariants of Binary Quintics and Sextics to one another and to the Skew Invariant of the same Weight of the Binary Nonics.

On Clebsch's "Einfachstes System associirter Formen" and its Generalization.

Note on the Ladenburg Carbon-graph.

Note on the Theorem contained in Prof. Lipschitz's Paper entitled "Demonstration of a Fundamental Theorem obtained by Mr. Sylvester" in Am. Jour. of Math., I, pages 336–341.

A Synoptical Table of the Irreducible Invariants and Covariants to a Binary Quintic, with a Scholium on a Theorem in Conditional Hyperdeterminants.

Notes on Determinants and Duadic Disynthemes. Two papers.

On the Complete System of the "Grundformen" of the Binary Quantic of the Ninth Order.

Tables of the Generating Functions and Groundforms for the Binary Quantics of the First Ten Orders.

On the Resolution of Numbers into the Sum or Difference of two Cubes.

In the Proceedings of the Royal Society, London.

The compiler of this list is informed that there are one or two communications by Professor Sylvester in the Proceedings of the Royal Society for 1878; but the Proceedings for that year are wanting in the Baltimore sets, and accordingly the titles cannot here be accurately stated.

In the Messenger of Mathematics, London.

Rule for Abbreviating the Calculation of the Number of In- or Co-Variants of a given Order and Weight in the Coefficients of a Binary Quantic of a given Degree. (1878).

Note on Continuants. (1878).

On a Theorem connected with Newton's Rule for the Discovery of the Imaginary Roots of Equations. (1879).

In the London, Edinburgh and Dublin Philosophical Magazine, London.

On a Generalization of Taylor's Theorem. (1877).

Proof of the Hitherto Undemonstrated Fundamental Theorem of Invariants (1878).

Note on an Equation of Finite Differences. (1879).

In the Educational Times, London.

Mathematical Questions for Solution, of an Original Character and embodying Distinct Theories, Monthly during the Years 1876–79, in Continuance of a Series, begun many years ago.

Journal für reine und angewandte Mathematik, (Crelle), Berlin.

Sur les actions mutuelles des formes invariantives dérivées. (1878).

Sur les déterminants composés. (1879).

Sur un déterminant symétrique qui comprend comme cas particulier la première partie de l'équation séculaire. (1879).

Note sur une propriété des équations dont toutes les racines sont réelles. (1879).

Sur l'entrelacement d'une fonction par rapport à une autre. (1879).

Preuve instantanée d'après la méthode de Fourier, de la réalité des racines de l'équation séculaire, (1879).

In the Comptes Rendus de l'Académie des Sciences de l'Institut de France.

Sur les invariants fondamentaux de la forme binaire du huitième ordre. (1877).

Sur une méthode algébrique pour obtenir l'ensemble des invariants et des covariants fondamentaux d'une forme binaire. (1877).

Sur une méthode algébrique pour obtenir l'ensemble des invariants et des covariants fondamentaux d'une forme binaire et d'une combinaison quelconque de formes binaires. (1877).

Sur le vrai nombre des covariants élémentaires d'un système de deux formes biquadratiques binaires. (1877).

Théorie pour trouver le nombre des covariants et des contrevariants d'ordre et de degré, donnés linéairement indépendants d'un système quelconque de formes simultanées, contenant un nombre quelconque de variables. (1877).

Sur les invariants. (3 papers.) (1877)

Sur la loi de réciprocité pour les invariants et covariants des quantics binaires. (1878).

Sur la théorie des formes associées de MM. Clebsch et Gordan. (1878).

Détermination d'une limite supérieure au nombre total des invariants et covariants irréductibles des formes binaires. (1878).

Sur les covariants fondamentaux d'un système cubo-quadratique binaire. (1878.)

Sur le vrai nombre des formes irréductibles du système cubo-biquadratique. (1878).

Détermination du nombre exact des covariants irréductibles du système cubo-biquadratique binaire. (1878).

Sur les covariants irréductibles du quantic du septième ordre. (1878).

Sur la forme binaire du septième ordre. (1878).

Sur la valeur moyenne des coefficients dans le développement d'un déterminant gauche ou symétrique d'un ordre infiniment grand et sur les déterminants doublement gauches. (1879).

Table des nombres de dérivées invariantives d'ordre et de degré donnés, appartenant à la forme binaire du dixième ordre. (1879).

Sur la valeur moyenne des coefficients numériques dans un déterminant gauche d'un ordre infiniment grand. (1879).

Sur une propriété arithmétique d'une certaine série des nombres entiers. (1879).

Sur le vrai nombre des covariants fondamenteaux d'un système de deux cubiques binaires.

BY DR. STORY.

In the American Journal of Mathematics.

On the Elastic Potential of Crystals.

Note on the Paper of MR. KEMPE, entitled the "Geographical Problem of the Four Colors," in the Am. Jour. of Math., II, 3.

By Dr. T. Craig.

Motion of a Point on the Surface of an Ellipsoid. (*Am. Jour. of Math*, *I*).

The Motion of a Solid in a Fluid. (*Am. Jour of Math*, *I*).

Mathematical Theory of Fluid Motion. (*Van Nostrand's Eng Mag.*, *1879*).

General Differential Equation for Developable Surfaces. (*Jour. of Franklin Inst.*, *1879*).

Projection of the General Locus of Space of Four Dimensions into Space of Three Dimensions. (*Am. Jour. of Math.*, *II*).

The Motion of an Ellipsoid in a Fluid. (*Am. Jour. of Math.*, *II*).

By Mr. F. Franklin.

Bipunctual Coordinates. (*Am. Jour. of Math.*, *I*).

On a Problem of Isomerism. (*Am. Jour. of Math.*, *I*).

Notes on Partitions of Numbers, etc. (*Am. Jour. of Math.*, *I*, *II*).

By Dr. G. B. Halsted.

Bibliography of Hyper-Space and Non-Euclidean Geometry. (*Am. Jour. of Math.*, *I*).

Note on the First English Euclid. (*Am. Jour. of Math*, *I*).

By Miss Christine Ladd.

Quaternions. (*Analyst*, *1877*).

The Polynomial Theorem. (*Analyst*, *1878*).

On some Properties of Four Circles Inscribed in One and Circumscribed about Another. (*Analyst*, *1878*).

On Pascal's Hexagram. (*Am. Jour. of Math.*, *II*).

By Mr. W. I. Stringham.

Some General Formulae for Integrals of Irrational Functions. (*Am. Jour. of Math.*, *II*).

The Quaternion Formulae for Quantification of Curves, Surfaces and Solids and for Barycentres. (*Am. Jour. of Math*, *II*).

PHYSICS.

By Professor Rowland.

The Magnetic Effect of Electrical Convection. (*Am. Jour. of Science*, *1878; abstract by Helmholtz in Monatsbericht d. Berlin Akad*).

Research on the Absolute Unit of Electrical Resistance. (*Am. Jour. of Science*, *1878*).

Note on the Theory of Electric Absorption. (*Am. Jour. of Math.*, *1878*).

On Professor Ayrton and Perry's New Theory of the Earth's Magnetism, with a Note on a New Theory of the Aurora. (*Philos. Mag.*, *1879*).

Note on the Magnetic Effect of Electrical Convection. (*Philos. Mag., 1879*).

On the Diamagnetic Constants of Bismuth and Calc-Spar in Absolute Measure, part I. (*Am. Jour. of Science, 1879*).

On the Mechanical Equivalent of Heat, with Subsidiary Researches on the Variation of the Mercurial from the Air Thermometer, and on the Variation of the Specific Heat of Water. (*Amer. Acad., Boston, in press*).

BY DR. HASTINGS.

The Influence of Temperature on the Optical Constants of Glass. (*Am. Jour. of Science, 1878*).

On Lockyer's Hypothesis, that the so-called Elements are Compound Bodies. (*Am. Chem Jour., 1879*).

On the Perfect Color Correction in Triple Objectives. (*Am Jour. of Science, 1879*).

BY DR. W. W. JACQUES.

Effect of the Motion of Air within an Auditorium upon its Acoustic Qualities. (*Jour. of Franklin Inst., 1878; Philos. Mag., 1879*).

Velocity of Very Loud Sounds. (*Am. Jour. of Science, 1879; Philos. Mag., 1879*).

Diamagnetic Constants of Bismuth and Calc-Spar Crystals in Absolute Measure, part II. (*Am Jour of Science, 1879*).

Distribution of Heat in the Spectra of Various Sources of Radiation. (*Am. Acad., Boston, 1879*).

BY MR. E. H. HALL.

On a New Action of the Magnet on Electric Currents. (*Am. Jour. of Math., 1879*).

CHEMISTRY.

1. Zur Kentniss des Phosphoroxychlorids. By IRA REMSEN. (*Berichte der deutschen chemischen Gesellschaft, 1876*).

2. Ueber die Xylolsulfamide. By IRA REMSEN. (*Berichte, &c., 1877*).

3. Ueber die Oxydation der Mesitylensulfosäure. By IRA REMSEN and L. B. HALL. (*Berichte, &c., 1877*).

4. Ueber die isomeren Sulfosäuren aus Paranitrotoluol. By IRA REMSEN and E. HART. (*Berichte, &c., 1877*).

5. Ueber die Oxydation der Sulfosäuren des Metaxylols. (By IRA REMSEN and M. W. ILES. (*Berichte, &c , 1877*).

6. Ueber Xylolsulfamide By IRA REMSEN. (*Berichte, &c., 1878*).

7. Ueber Chlorcymol aus Thymol u. s. w. By IRA REMSEN. (*Berichte, &c., 1878*).

8. Nichtexistenz einer zweiten Dioxybenzoesäure aus Disulfobenzoesäure. By IRA REMSEN. (*Berichte, &c., 1878*).

9. Oxydation der Xylolsulfosäuren. By IRA REMSEN and M. W. ILES. (*Berichte, &c., 1878*).

10. Oxydation der Xylolsulfamide. By IRA REMSEN and M. W. ILES. (*Berichte, &c., 1878*).

11. Neue Bildungsmethode der *a*-Oxyisophthalsäure. By IRA REMSEN and M. W. ILES. (*Berichte, &c., 1878*).

12. Oxydation des Bromäthyltoluols und ähnlicher Substitutionsprodukte. By IRA REMSEN and H. N. MORSE. (*Berichte, &c., 1878*).

13. Neue Methode zur quantitativen Bestimmung von Schwefel. By C. FAHLBERG and M. W. ILES. (*Berichte, &c., 1878*).
14. Neue Darstellungsmethode der Acetylamidophenole. By H. N. MORSE. (*Berichte, &c., 1878*).
15. Ueber die Oxydation des Orthotoluolsulfamids. By C. FAHLBERG and IRA REMSEN. (*Berichte, &c., 1879*).
16. On the Oxidation of Aromatic Substitution-products. By IRA REMSEN. (*Am. Chem. Jour., 1879*).
17. On the Oxidation of Xylenesulphamides. By IRA REMSEN and M. W. ILES. (*Am. Chem. Jour., 1879*).
18. On the Oxidation of Bromparaethyltoluene. By IRA REMSEN and H. N. MORSE. (*Am. Chem. Jour., 1879*).
19. An Apparatus for Gas Analysis. By A. V. E. YOUNG, (*Am. Chem. Jour., 1879*).
20. On the liquid Toluenesulphochloride. By C. FAHLBERG. (*Am. Chem Jour., 1879*).
21. Ueber Oxydationsprodukte aus Xylolsulfamid. By L. B. HALL and IRA REMSEN. (*Berichte, &c., 1879*).
22. Ueber die Anhydrosulfaminisophthalsäure. By IRA REMSEN and R. D. COALE. (*Berichte, &c., 1879*).

This list does not include some addresses and semi-popular articles which have been published.

BIOLOGY.

1. The Effect of Stimulation on an Excised Nerve. By WILLIAM LEE, M. D. (*New York Medical Record*).
2. Report on the Hydroids of Alaska. By S. F. CLARKE. (*Scientific Results of Exploration of Alaska. Smithsonian Institution*).
3. *Normal Respiratory Movements of the Frog and the Influence upon its Respiratory Centre of Stimulation of the Optic Lobes. By H. N. MARTIN. (*Journal of Physiology, Vol. I, Nos. 2 and 3*).
4. *The Development and Regeneration of the Gastric Glandular Epithelium during Fœtal Life and after Birth. By HENRY SEWALL. (*Journal of Physiology, Vol. I, Nos. 4 and 5*).
5. Report on the Hydroids Collected in the Exploration of the Gulf Stream and the Gulf of Mexico. By S. F. CLARKE. (*Bull. Mus. Comp. Zoöl., Cambridge*).
6. On the Development of the Smelt. By H. J. RICE. (*Report Maryland Fish Commission, 1878*).
7. *The Influence of Stimulation of the Midbrain upon the Respiratory Rhythm of the Mammal. By H. NEWELL MARTIN and W. D BOOKER, M. D.
8. *The Botanical Relations of Trichophyton Tonsurans. By I. EDMUNDSON ATKINSON, M. D. (*New York Medical Journal, Dec., 1878*).
9. *† Preliminary Observations on the Development of Marine Prosobranchiate Gasteropods. By W. K. BROOKS.
10. †The Larval Stages of Squilla Empusa. By W. K. BROOKS.
11. †The Development of Lingula and the Systematic Position of the Brachiopoda. By W. K. BROOKS.
12. On the Development of the Shad. By H. J. RICE. (*Report Maryland Fish Commission, 1878*).
13. On the Respiratory Function of the Internal Intercostal Muscles. By H. N. MARTIN and E. M. HARTWELL. (*Journal of Physiology, Vol. II, No. 1*).

14. Observations on the Physiology of the Spinal Cord. By ISAAC OTT, M. D. (*Journal of Physiology, Vol. II, No. 1*).

15. On the Effect of Two Succeeding Stimuli upon Muscular Contraction. By HENRY SEWALL. (*Journal of Physiology. Vol. II, No 2*).

16. On the So-called Heat-Dyspnœa. By CHRISTIAN SIHLER, M. D. (*Journal of Physiology, Vol. II, No. 3*).

17. †List of animals found at Fort Wool. By P. R. UHLER.

Semi-popular articles are excluded from this list, which contains only papers based on original researches or observations made in the Laboratory of the University or its summer marine offshoot, the Chesapeake Zoölogical Laboratory. A considerable portion of the work of the session 1878-79 is not yet published.

*The papers marked with an asterisk were re-printed in a volume of "Studies from the Biological Laboratory, Session 1877-78," published by Murphy & Co., Baltimore. A similar volume for the session 1878-79 is nearly ready.

†The papers marked † were published in a volume containing the results of the work at the Marine Laboratory at Fort Wool in the summer of 1878. This volume also contained the following papers based on observations or collections made at the Summer Laboratory, but not written by members of the University—

Land Plants found at Fort Wool. N. B. Webster.

Lucifer typus. Walter Faxon.

PHILOLOGY.

By Professor GILDERSLEEVE.

Justin Martyr. Apologies, and Epistle to Diognetus. Ed. with introduction and notes. N. Y., 1877.

On εἰ with the Future Indicative and ἐάν with the Subjunctive in the Tragic Poets. (*Amer. Philol. Assoc., Trans., 1876*).

Personal Reminiscences of Friedrich Ritschl. (*Amer. Philol. Assoc., Proc., 1877*).

Contributions to the History of the Articular Infinitive in Greek. (*Amer. Philol. Assoc., Trans., 1878*).

Encroachments of μή upon οὐ in Later Greek. (*Am. Philol. Assoc., Proc , 1879*).

Classics and Colleges. (*Princeton Review, 1878*).

University Work in America. (*Princeton Review, 1879*).

By Mr. H. C. G. BRANDT.

The Roman Alphabet in German. (*Amer. Philol. Assoc., Proc., 1878*).

By Mr. A. S. COOK.

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