JOHNS HOPKINS UNIVERSITY CIRCULARS.

Published with the approbation of the Board of Trustees.

Baltimore, March, 1881.

[Price 5 Cents.]

Calendar.

April 15-18. Spring Recess.
May 2. Session of Marine Laboratory at Beaufort Begins.
June 10. Present Term of Instruction Closes.
September 20. Sixth Academic Year Begins.
September 27. Instructions Resumed.

CONTENTS.

Calendar, Times of Meeting of University Societies, Academic Staff, List of Instructors and Students in Biology, Biology, 1876-81: Introductory Note, Graduate Instruction and Opportunities for Research, Undergraduate Courses, Specific Statements: Animal Physiology, Animal Morphology, Botany, Libraries, Publications, Special Students, Classes for School Teachers, Demonstrations to Medical Students, Fellowships, Societies, Schedule of Instruction for Undergraduates, Courses of Lectures, 1875-81, 101 101 102 103 104 105 105-108 105 106 107 107 107 107 108 108 108 109 110

CHESSPEAKE ZOOLOGICAL LABORATORY: 111

Courses Preliminary to the Study of Medicine:

Collegiate Course: 117
Matriculation, 117
Summary of the Course, 117
Explanation of the Course, 118
Course for Non-Matriculated Students, 118
Entrance Examination, 119
Summary of the Course, 119
Explanation of the Course, 119
Special Students, 119
Scientific Periodicals, 120

MEETINGS OF SOCIETIES.

Scientific. First Wednesday of each month at 8 P. M. Next meeting, April 6.
E. H. Hall, Secretary.

Philological. First Friday of each month, at 12 M. Next meeting, April 8.
M. Warren, Secretary.

Metaphysical. Second Tuesday of each month, at 8 P. M. Next meeting, April 12.
Allan Marquand, Secretary.

Historical and Political Science. Third Friday of each month, at 8 P. M. Next meeting, March 18.
H. B. Adams, Secretary.

Mathematical. Third Wednesday of each month, at 8 P. M. Next meeting, March 16.
O. H. Mitchell, Secretary.

Naturalists' Field Club. Excursions each Saturday during the Spring and Autumn. Regular meetings for the reading and discussion of papers once a month.
E. M. Hartwell, Secretary.
ACADEMIC STAFF, 1880–81.

ACADEMIC COUNCIL.

Daniel C. Gilman.  President of the University.

A. B., Yale College, 1832, and A. M., 1855; LL. D., Harvard University and St. John's College, 1877; Professor in Yale College, 1862–72; President of the University of California, 1872–76.

Basil L. Gildersleeve.  Professor of Greek.

A. B., Princeton College, 1849, and A. M., 1852; Ph. D., University of Göttingen, 1853; L. L. D., College of William and Mary, 1862; Professor of Greek in the University of Virginia, 1856–76; Professor of Latin in the University of Virginia, 1856–60.

H. Newell Martin.  Professor of Biology.

M. B., University of London, 1871, and Dr. Sc., 1872; A. B., University of Cambridge, 1874, and A. M., 1877; Fellow, and late Lecturer on Natural History in Christ College, Cambridge; Fellow of University College, London.

Charles D. Morris.  (College) Professor of Latin and Greek.


Ira Remsen.  Professor of Chemistry.

College of the City of New York; M. D., College of Physicians and Surgeons, N. Y., 1867; Ph. D., University of Göttingen, 1873; Professor of Chemistry in Williams College, 1873–76, and previously Assistant in Chemistry in the University of Washington.

Henry A. Rowland.  Professor of Physics.

G. E., Rensselaer Polytechnic Institute, Troy, 1870; Assistant Professor in the same, 1872–75; Ph. D., Johns Hopkins University, 1880.

J. J. Sylvester.  Professor of Mathematics.

A. M., University of Cambridge; F. R. S., London and Edinburgh; Corresponding Member, Institute of France; Member, Academy of Sciences in Berlin, Göttingen, Naples, Milan, St. Petersburg, etc.; L. D., University of Illinois, University of Kielburg; D. C. L., University of Oxford; Honorary Fellow of St. John's College, Cambridge; late Professor of Mathematics in the Royal Military Academy, Woolwich.

LECTURERS, 1880–81.

A. Graham Bell.  Professor of Phonology.

Ph. D., National Deaf Mute College, 1880.

S. P. Langley.  Professor of Physics.

Director of the Astronomical Observatory, Allegheny, Pa.

Sidney Lanier.  Professor of English Literature.

Georgia Morris.  Professor of History of Philosophy.

A. B., Dartmouth College, 1860, and A. M., 1864; late Professor in the University of Michigan.

Charles S. Pierce.  Professor of Logic.

A. B., Harvard University, 1859, A. M., and S. B., 1862; of the U. S. Coast and Geodetic Survey.

Léonard Rabinoff.  Professor of French Literature.

Bach. et Litt., Université de France, 1832, and Lizenzié auf Driti, 1835.

ASSOCIATES.

Herbert B. Adams.  Professor of History.

A. B., Amherst College, 1872; Ph. D., University of Heidelberg, 1876; Lecturer on History at Smith College.

Her mann C. G. Brandt.  Professor of German.

A. B., Hamilton College, 1872, and A. M., 1875; Assistant Professor of Modern Languages in Hamilton College, 1874–75.

William K. Brooks.  Professor of Biology.

A. B., Williams College, 1870; Ph. D., Harvard University, 1874; Director of the Chesapeake Zoological Laboratory.

William Hand Browne.  Professor of Librarian.

M. D., University of Maryland, 1850.

Albert S. Cook.  Professor of English.

S. B., Rutgers College, 1872, and S. M., 1876.

Thomas Craig.  Professor of Mathematics.

C. E., Lafayette College, 1872; Ph. D., Johns Hopkins University, 1876; of the U. S. Coast and Geodetic Survey.


A. B., Princeton College, 1877, and A. M., 1879; Tutor of Greek in Princeton College, 1875–76.

A. Marshall Elliott.  Professor of Romance Languages.

A. B., Harvard College, 1868, and A. M., 1876; Ph. D., Harvard University, 1885.

Charles S. Hastings.  Professor of Physics.

Ph. B., Yale College, 1870, and Ph. D., 1873; Holder of the "Tyndall Scholarship" in Paris.

Harmon N. Morse.  Professor of Chemistry.

A. B., Amherst College, 1872; Ph. D., University of Göttingen, 1876; Instructor in Chemistry at Amherst College, 1875–76.

Austin Scott.  Professor of History.

A. B., Yale College, 1880; A. M., University of Michigan, 1871; Ph. D., University of Leipzig, 1873; late Instructor in History at the University of Michigan.

Henry Sewall.  Professor of Biology.

B. S., Wesleyan University, 1876; Ph. D., Johns Hopkins University, 1877.

William E. Story.  Professor of Mathematics.

A. B., Harvard University, 1871; Ph. D., University of Leipzig, 1874; Tutor of Mathematics in Harvard College, 1875–76.

Philip R. Uhler.  Professor of Natural History.

A. B., Johns Hopkins College, 1867; Ph. D., University of Strasbourg, 1879.

Minton Warren.  Professor of Latin.

A. B., Telfos College, 1872; Ph. D., University of Strasbourg, 1879.

ASSISTANTS.

Henry C. Adams.  Professor of Political Economy.

A. B., Iowa College, 1874, and A. M., 1877; Ph. D., Johns Hopkins University, 1878; Lecturer at Cornell University, 1879; and at the University of Michigan, 1879.

Samuel F. Clarke.  Professor of Biology.

Ph. B., Yale College, 1828; Ph. D., Johns Hopkins University, 1879.

Fabian Franklin.  Professor of Mathematics.

Ph. B., Columbia University, 1869; Ph. D., Johns Hopkins University, 1880.

Edwin H. Hall.  Professor of Physics.

A. B., Bowdoin College, 1875; Ph. D., Johns Hopkins University, 1880. Appointed to the "Tyndall Scholarship", 1880.

Philippe B. Marceau.  Professor of French.

Ph. B., University of France, 1876, and A. M., 1879.

William T. Sedgwick.  Professor of Biology.

Ph. B., Yale College, 1877.

George H. Stockbridge.  Professor of German and Latin.

A. B., Bates College, 1872, and A. M., 1875.

FELLOWS.

Louis Brevik.  Professor of Greek.

A. B., Rutgers College, 1878.

Maurice Bloomfield.  Professor of Philosophy.

A. B., Harvard University, 1877; Fellow of the Johns Hopkins University, 1878–78; Ph. D., 1879; Student of Philosophy at the University of Leipzig, 1880–83.

James W. Bright.  Professor of Textic Languages.

A. B., Lafayette College, 1877, and A. M., 1879.

Benjamin C. Burt.  Professor of Philosophy.

A. B., University of Michigan, 1876, and A. M., 1879.

R. Dorssey Coale.  Professor of Chemistry.

A. B., Harvard University, 1876, and A. M., 1877; Professor in Antioch College, Ohio.

Lawrence B. Fletcher.  Professor of Physics.

A. B., Columbia College, 1877, and A. M., 1879; Fellow of Columbia College, 1875–76.

Spencer H. Freeman.  Professor of Biology.

A. B., University of Rochester, 1875, and A. M., 1878.

Edward M. Hartwell.  Professor of Biology.

A. B., Amherst College, 1875, and A. M., 1875.

Mitsuru Kihara.  Professor of Chemistry.

S. B., University of Tokyo, Japan, 1877.

Allan Marquand.  Professor of Logic and Ethics.

A. B., Princeton College, 1874; Fellow of the Johns Hopkins University, 1878–79; Ph. D., 1880.

Oscar H. Mitchell.  Professor of Mathematics.

A. B., Marist College, 1875, and A. M., 1876.

Kakichi Mitsukuri.  Professor of Biology.

S. B., Cornell University, 1874, and A. M., 1877; Professor in Antioch College, Ohio.

Edward F. Nichols.  Professor of Physics.

S. B., Cornell University, 1875; Ph. D., University of Göttingen, 1879; Fellow of the Johns Hopkins University, 1879–80.

George F. Nicolasen.  Professor of Greek.

A. B., University of Virginia, 1875, and A. M., 1878.

Bernard F. O'Connor.  Professor of Romance Languages.

Bach. et Litt., Université de France, 1874.

Chase Palmer.  Professor of Chemistry.

A. B., Johns Hopkins University, 1879.

Herbert M. Perry.  Professor of Mathematics.

A. B., Harvard University, 1880.

Robert W. Prentiss.  Professor of Mathematics.

S. B., Rutgers College, 1878.

A. F. Wilhelm Schmipfel.  Professor of Biology.

Ph. D., University of Strasbourg, 1878.

Henry A. Short.  Professor of Greek.

A. B., Columbia College, 1880; now Fellow of Columbia College.

Edward H. Speicher.  Professor of Greek.

A. B., Johns Hopkins University, 1879.

Morrison I. Swift.  Professor of Philosophy.

A. B., Williams College, 1879.

Charles A. Van Velzer.  Professor of Mathematics.

S. B., Cornell University, 1876.

Edmund B. Wilson.  Professor of Biology.

Ph. B., Yale College, 1878.
INSTRUCTORS AND GRADUATE STUDENTS IN BIOLOGY, 1876–81.

GRADUATE STUDENTS IN BIOLOGY, 1876–81.

The following list contains only the names of graduate students who have, while attending the University, given most of their time to biological study or research. Physicians in active practice and merely taking a course of instruction in Histology or Physiology are not included in it, but those who have given a considerable portion of their time to study while with us, or who have carried on researches in the Laboratory are enumerated. The list of advanced students who have studied at the seaside laboratory will be found on p. 111.

H. NEWELL MARTIN. (Professor of Biology. M. D., University of London, 1871, and Dr. Sc., 1872; A. B., University of Cambridge, 1874, and A. M., 1877; Fellow, and late Lecturer on Natural History in Christ College, Cambridge; Fellow of University College, London.

WILLIAM K. BROOKS. Associate Professor of Comparative Anatomy, Director of the Seaside Laboratory. A. B., Williams College, 1872; Ph. D., Harvard University, 1873.

HENRY SEWALL. (Assistant in Biological Laboratory, 1876–78.) Associate, Assistant Professor of Animal Physiology. N. D., University of London, 1871, and D. Sc., 1872; A. B., University of Cambridge, 1874, and D. B., Yale College, 1877; Graduate Student of Biology, and Assistant in Laboratory, 1876–78; Ph. B., Yale College, 1878; Fellow in Biology, Johns Hopkins University, 1878–79; Ph. D., Yale College, 1879; Assistant in Biological Laboratory, 1880–81.

SAMUEL F. CLARKE. (Assitant in Biology, 1876–80.) Instructor of Elementary Summer School, 1880–81. Ph. B., Yale College, 1876; Fellow in Biology, Johns Hopkins University, 1878–79, and Ph. D., 1881.

WILLIAM T. COUNCILMAN. Assistant in Biology, 1878–79. St. John’s College; M. D., University of Maryland, 1878.

CHRISTIAN SHILLER. Assistant in Biology, 1879–80. Concordia, 1866; M. D., University of Michigan, 1871; Fellow in Biology, Johns Hopkins University, 1878–79, and Ph. D., 1881.


Lecturers in Biology, 1876–81.

WILLIAM JAMES, M. D., of Harvard University, on “THE SENSES AND THE BRAIN.” (1878.)

WILLIAM G. FARLOW, M. D., of Harvard University, on “Vegetable Morphology, etc.” (1879.)

Fellows in Biology, 1876–81.

WILLIAM K. BROOKS, Ph. D.

From Cleveland, Ohio; A. B., Williams, 1872; Ph. D., Harvard, 1874; Assistant, Boston School of the Sacred Heart, 1872–74; Assistant in Biology before entering Concords, 1866; M. D., University of Michigan, 1871; Fellow in Biology, Johns Hopkins University, 1878–79, and Ph. D., 1881.

SAMUEL F. CLARKE, Ph. D.

From Georgia, Ill.; Assistant Zoologist, U. S. Fish Commission, 1874–75; Assistant in Zoology in Sheffield Scientific School, 1874–76; Ph. B., Yale, 1879; Ph. D., Johns Hopkins, 1879; Assistant in Biological Laboratory, 1879–80, and Instructor of Elementary Summer School, 1880–81. (1876.)

EDWARD M. HARTWELL, A. M.

From Littleton, Mass.; Pablico Latin School, Boston, Mass., 1869; A. B., Amherst, 1873, and A. M., 1878; Vice-Principal of High School. Grinnell, N. J., 1873–74; Instructor in Public Latin School, Boston, 1874–77; Student at M gaming Medical School, Cleveland, Ohio, 1875–78; Graduate Student of Biology and Chemistry, 1879–80. (1879.)

KARICHI MITSUKURI, Ph. B.

From Tokyo, Japan; Ph. B., Yale, 1879; Graduate Student of Biology, 1879–80. (1880–81.)

ISAAC OTT, M. D.

From Easton, Pa.; M. D., University of Pennsylvania, 1880; Resident Physician in St. Mary’s Hospital; Instructor in Experimental Physiology in the University of Pennsylvania, 1876–77; A. M., Lafayette, 1877; Physician, Event, Mainly Animal Physiology or Histology) given in the Biological Department.

HENRY J. RICH, M. S.

From Cambridge, N. Y.; B. S., Cornell, 1877, and M. D., 1880; Student of Biology, University of France, Paris, 1879; Assistant, U. S. Fish Commission, 1879; Professor of Natural Sciences at Michigan Military Academy, Orchard Lake, Michigan. (1876–78.)

A. F. WILHELM SCHUMPER, Ph. D.

From Strassburg, Germany; Gymnasium at Strassburg, 1874–75; Ph. D., Strassburg, 1878; Assistant and Provisional Director in the Museum of Natural History, Strassburg, 1878–80.

WILLIAM T. SEDGWICK, Ph. B.

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; Assistant in Biological Laboratory. (1878–80.)

HENRY SEWALL, Ph. D.

From Baltimore; B. S., Western, 1874; Graduate Student of Biology, and Assistant in Laboratory, 1876–77; Ph. D., Johns Hopkins, 1879; Student of Physiology at Leipsic, 1877–81; Associate in Biology. (1876–79.)

CHRISTIAN SHILLER, M. D., Ph. D.

From Cambridge, Mass.; A. B., Cornell, 1869; M. D., University of Michigan, 1871; Assistant in Biological Laboratory, 1879–81, and Ph. D., Johns Hopkins, 1881; Physiologist, Cleveland, Ohio. (1879–81.)

CHARLES O. WHITMAN, Ph. D.

From Newton Highlands, Mass.; A. B., Bowdoin, 1874, and A. M., 1874; Ph. D., Leipzig, 1876; appointed Professor of Zoology at the University of Tokyo, Japan, before entering the Fellowship. (1878.)

EDMUND BEECHER WILSON, Ph. B.

From Geneva, Ill.; Ph. B., Yale, 1878; Assistant in Zoology at Yale College, 1879–81. (1879.)
BIOLOGY, 1876-81.

INTRODUCTORY NOTE.

In the organization of this University, prominence was given to the study of Biology, partly because of its importance as a science, considered by itself, and partly because of its fundamental relations to the science of Medicine. The founder of the University was also the founder of a Hospital, now in process of construction upon a wise and generous plan, and it was his wish, as it is the purpose of his trustees, that the University and the Hospital should cooperate in the promotion of medical and sanitary science. Consequently much thought has been given in the Johns Hopkins University to the subject of medical education, and although the time has not yet come for the appointment of a medical faculty or the announcement of professional courses of study, an effort has been made to give a thorough foundation for such courses by instruction in Physics, Chemistry and Biology, as well as in Mathematics and Language. Under the term Biology it is intended to include Physiology and Morphology, both Animal and Vegetable.

A Professor of Biology, who had won many academic honors and was familiar with the methods employed and the principles recognized in the best laboratories of England and the continent, was appointed in 1876, and requested to organize among us this department of instruction. An Associate Professor was designated soon afterward, to whom the branches of Morphology and Comparative Anatomy were assigned, thus leaving the Professor of Biology freer to direct the general administration of the laboratory and to carry forward instruction and researches in Physiology, in accordance with his personal preferences. Other Assistants have been engaged from time to time, and three of the Fellowships have been regularly allotted to students of Biology.

The following statements which come from the Biological Laboratory are printed for the information of all who are interested in observing the results of our work; and also, particularly, to show to young men and their parents what facilities are offered for laying a suitable foundation for the subsequent study of Medicine. It is also thought that abroad as well as at home the encouragement here given to investigation and publication will be noticed with interest.

President's Office,
JOHNS HOPKINS UNIVERSITY, March 10, 1881.

D. C. Gilman.

GRADUATE INSTRUCTION AND OPPORTUNITIES FOR RESEARCH.

In organizing the graduate work, in which more than half the students of the department are engaged, several facts had to be taken into consideration; foremost among them being the impossibility of immediately furnishing a complete equipment for the highest study in all the subdivisions of biological science without such a disproportionate expenditure of the funds of the University as would be unjust to other branches of learning. Instead of endeavoring to do everything tolerably well, it was thought better to select a few topics to begin with, and to attempt to afford the very best facilities possible in these, leaving others to be taken up successively as opportunity offered. The choice has been mainly determined, by two considerations (1) by the fact that the founder of the University especially desired it to cooperate with the Johns Hopkins Hospital in advancing medical education and science, and (2) by regard to the general policy of the University, in accordance with which, when a choice is possible between two subjects in which to afford special facilities for the most advanced study and to encourage research, that one is selected in which such facilities are less commonly met with elsewhere in the United States; in this way an attempt is made rather to complement than to rival the work of other institutions giving higher instruction.
The University allows an undergraduate student to select his plan of study from any one of several schedules which are laid down by the authorities. Among the subjects which he may take up, after studying Physics and Chemistry, is Biology, and this study is recommended to those who are preparing themselves to enter at a later period upon the professional study of Medicine.

When the undergraduate enters the Biological Laboratory, he does not at once begin the study of Botany or Zoölogy, or any subdivision of these, but gives attention during the first year to General Biology—to acquiring a general knowledge of the forms assumed and the properties exhibited by living matter. For this purpose the student commences with the study of unicellular organisms; is next carried on through a series of types selected from the higher Fungi, the crypto-gamous, and the flowering plants; and is finally made to examine thoroughly a specimen from each class in the animal kingdom. These types form the texts for lectures and recitations upon general biological laws and the phenomena which they are selected to illustrate; but the main work is done in the Laboratory, so that the instruction has a firm practical basis, and the various technical terms are made intelligible through their illustration by the observations of the student himself. Having formed a good acquaintance with a number of adult forms the student next takes up Embryology, the lectures on which are illustrated by a thorough practical study of the development of the chick, and a less extensive one of the developmental histories of some other animals. During this preliminary course the student also, with the aid of a selected series of skeletons, studies the main facts in Human and Comparative Osteology. After its completion some specialization of study is permitted, and the more advanced student is the more is this encouraged; in the next year, he may select Animal Physiology with Histology, or Animal Morphology, for more detailed study; and it is hoped that Botany will very soon be added to the list.

This undergraduate course, while primarily designed as a stepping stone for those who intend to become Biologists, is at the same time complete in itself, and believed to be the form of biological instruction best adapted for those who do not expect to become either Botanists, Zoölogists, or Physiologists, but who desire to acquire some knowledge of the methods and ideas of modern Biology, as one of the branches of general culture which they select among the studies leading to the baccalaureate degree.

**SPECIFIC STATEMENTS IN RESPECT TO THE SUB-DIVISIONS OF BIOLOGICAL STUDY.**

**Animal Physiology.**

The relations of the University to the Hospital seemed from the first to indicate Animal Physiology as a subject having special claims on us, and this opinion was confirmed by a consideration of the present status of that science in this country. Notwithstanding a small number of brilliant physiological discoveries made in the United States, and the fact that several distinguished physiological investigators are found here, it can hardly be said that America has taken her fair part in contributing to the modern advance of Physiology. The costliness and variety of the accurate instruments required for modern physiological research almost preclude any but a well-endowed institution from obtaining them; hence the majority of medical students, even had they time, have not the opportunity of acquiring that practical knowledge of the methods of physiological inquiry which is so valuable an auxiliary in those therapeutical and pathological researches, which, conducted on the modern experimental method, have added so much in late years to the list of remedial agents at the disposal of the practising physician. Numerous good teachers do, no doubt, give instruction concerning those main facts already acquired which it is essential for the practitioner to know, but it seemed important to introduce a graduate course to train men as specialists in Physiology, so that they might not only be qualified to teach it, but to add to our knowledge of the working of the living body, and to supply new facts for the physician to utilize. While Chemistry has made good its position as a science which, though essential to those who practice medicine, has claim to a place in the circle of sciences apart from that or any other immediate practical application, Physiology has only recently begun to advance into that fortunate position and to be pursued for its own sake, as it now is in many European countries; as yet, in the United States it is but little studied, except in immediate connection with a medical curriculum. Manifold experience has, however, shewed that a science rarely makes important advances when pursued merely as a means to some specific end to which it is made secondary; and as modern advances in the investigation of the action of drugs and in the comprehension of pathological phenomena are more and more arrived at by reasonings based on physiological results and by experiments carried on by physiological methods, the time seems to have arrived when, at least in certain centres, Physiology should be made a subject of independent study.

For the reasons briefly stated above, Animal Physiology has formed one of the subjects for special advanced study selected by the Johns Hopkins University; and of its subdivisions, more attention is given to what is commonly known as “Experimental” than to “Chemical” Physiology, the latter being already fairly well provided for in several colleges. Of Animal Histology the same may be said. Therefore, while arrangements were made to enable any student to verify for himself the main points established in Animal Chemistry and Histology, the chief endeavor has been to provide special facilities in the so-called Experimental Physiology, and the instruments brought together for advanced study and research in that branch of knowledge are believed to be more numerous and to cover a wider ground than those to be found elsewhere in this country. The Laboratory is conveniently arranged for advanced work, the rooms occupied by those engaged in it being shut off from the General Laboratory fitted up for the junior students.
As to the method of selecting instruments the following statements may be of interest. Before the opening of the University the Trustees placed at the disposal of Professor Martin, to whom was entrusted the organization of the biological department, a considerable sum, which was mainly expended in procuring the instruments and appliances essential for the various branches of undergraduate biological work. For instance, a number of microscopes were purchased, so that each student should have one for his own use; also the apparatus necessary to enable every one to repeat for himself, (as he is required to do when pain to an animal is not involved), the more easy physiological experiments, and the apparatus necessary for the demonstration of such fundamental physiological facts as are too difficult for the less advanced students to carry out for themselves. Since that time the Trustees have yearly provided $1,000 for the purchase of new instruments; of these some are selected from those which have been described within the preceding twelve months and seem of value, or which, though older, are of general usefulness in the laboratory; the remainder are purchased for the execution of special investigations, so that, within reasonable limits as to cost, any one engaged in a research can have purchased or constructed for him such instruments as he may require. The collection of apparatus is, therefore, somewhat unique; starting with the general outfit of a physiological laboratory, and growing by the constant addition of the more generally useful instruments for demonstration and class-work, it also contains many pieces of apparatus which were ordered for special ends; and both groups are added to yearly.

A competent mechanic, at work on the premises, constructs some of the new apparatus, and also, which is more important, is always at hand for the immediate repair of any instrument which may get out of order.

Animal Morphology.

Arrangements having been made to afford instruction and the means of research in Animal Physiology, and very special facilities for advanced work in some of its branches, the next question for consideration was what should be done to promote graduate study in Zoology and Comparative Anatomy. Here again the best principle to adopt seemed to be, after arranging to give the ordinary undergraduate instruction as well as some of the more essential appliances for advanced work in all branches of Zoology, to select for special effort and encouragement the subdivision which should appear to be least commonly or efficiently promoted elsewhere.

Facilities for advanced work in Systematic Zoology were already well provided in many educational institutions and also in connection with the National Coast and Territorial Surveys, and the National and State Fish Commissions. Of Comparative Anatomy, so far as adult forms are concerned, almost the same may be said, but, with some well known exceptions, the study of the development of individual animals, considered in connection with problems of general Animal Morphology, has received less attention; although the American Fauna affords many unique opportunities, and it is now generally believed that all scientific systems for the classification of animals and the recognition of homologies in the organs of different species, genera, and classes, must be mainly based on the study of the developmental histories of individuals.

The University has accordingly not undertaken the formation of any extensive museum; such typical specimens are provided as are requisite for the satisfactory instruction of ordinary students of Zoology, but there has been no attempt to bring together a vast collection, such as specialists in Systematic Zoology require for their work. Such collections are found in several other educational centres, and, therefore, in accordance with the general principles of the University, were not considered as of primary importance here; while the fact that the National Collections at Washington are within easy reach of persons residing in Baltimore should any point needing reference to a large museum arise, made it possible for the present to postpone the founding of a Museum of Natural History. Whether the University will ever undertake this task is a question for future decision. No doubt ready access to an extensive collection is of vast importance to every zoologist, a museum being to him very much what a great library is to the philologist.

We may perhaps hope that what Peabody has done in founding a great reference library in Baltimore, which has freed the University Trustees from the necessity of expending their income for that purpose, may some day be supplemented for the biologists through the endowment by some citizen of a Natural History Museum, the organization of which shall be entrusted to experts, so that, while a source of recreation and instruction to the general public, it shall also be available for scientific work.

After the selection of Comparative Embryology as the subject in which to make a special endeavor to afford opportunities for advanced study and research, the next question which presented itself to the authorities of the University was how best to provide here. A consideration of the results accomplished in the private laboratory maintained by Mr. Alexander Agassiz at Newport, and in the Seaside Laboratories supported by several societies and universities, seemed to indicate as the best thing the foundation of a Marine Laboratory for advanced students; and also to make desirable its location as far south as convenient, since the organized facilities for seaside zoological study are at present much greater in the northern than in the southern parts of the Atlantic seaboard. In the summer of 1878 such a laboratory was opened at Fortress Monroe on the western shore of the Chesapeake, Professor Martin being immediately responsible to the Trustees for advising its foundation and for its management in accordance with the general plan of the biological department, though in justice to Dr. Brooks, Associate in Biology, it is incumbent to state that the idea originated with him, that he, as its Director, has had the immediate control of the organization of the Marine Laboratory from the outset, and that to him is almost entirely due the success which has attended it. In 1879, the Marine Laboratory was reopened at Crisfield, on the eastern shore of the Chesapeake, and later in the season moved to its previous location near Fortress Monroe. In 1880, it was conducted at Beaufort, N. C., and will return there next season.

Seaside Summer Schools for more or less elementary teaching in Zoology have for some years been conducted in the United States, and the National Fish Commission has for some time annually afforded valuable opportunities to specialists, but the foundation by a University of a Marine Laboratory for advanced study and research, in connection with which no definite teaching was given, but which afforded to qualified workers opportunities for original investigation and not previously attempted in this country. The results of the experiment, concerning which some details will be found on a subsequent page, have been very satisfactory. A steam launch, fitted up for dredging purposes, has been purchased, microscopes and other necessary apparatus are provided by the University, and those who can shew that they already possess such knowledge as may be expected to qualify them for advanced study, are received as students on the payment of a small fee.

Every year since the organization of the Marine Laboratory applications for admission to it have been received from persons who, on further investigation, were found to be not fully fitted to occupy a place in a laboratory primarily designed for research and for advanced study. As several Summer Schools for elementary instruction in Marine Zoology already existed in the United States no special effort was made to accommodate such candidates. Last summer, however, several of the junior students of the University having expressed a desire to spend some time in study at the seaside, a more elementary marine laboratory was organized under the superintendence of Dr. S. F. Clarke, Assistant in the Biological Laboratory. The place selected was that near Fortress Monroe previously occupied by the laboratory for advanced students, and which was known to afford good conditions for advanced work.
opportunities for study; as members of the Johns Hopkins University did not occupy all the accommodation available, several persons from elsewhere were received as students. In future, there is a strong probability that if a sufficient desire for summer teaching in Zoology is manifested among the undergraduates of the University, a similar class will be organized, (see p. 112).

Botany.

The next subject taken up with a view to providing opportunities for advanced study will probably be Botany and, if possible, either Comparative Vegetable Morphology or Vegetable Physiology will be selected for special encouragement. Systematic and Structural Botany are already so well provided for elsewhere and attract such a large proportion of American botanists, that their claim is obviously less pressing.

At present undergraduates are taught the fundamental facts of botanical science, and, in connection with a Field Club, have the opportunity to acquire a knowledge of the Flora of the Baltimore district, the specimens collected at each weekly excursion being subsequently examined and described under the direction of one of the instructors. During a part of the academic year 1878–79, Professor Farlow, of Harvard College, gave some advanced botanical instruction.

Libraries.

The main reference library of the biological department, as of all others in the University, is that of the Peabody Institute, within three or four minutes walk. In it are contained complete sets of nearly all the more important biological periodicals and of the proceedings of learned societies, as also other works of reference.

Except in the case of books likely to be frequently required for consultation the University has not attempted to duplicate those found in the Peabody Library; and such biological works as it possesses have been selected on the same principle as the physiological instruments. Those which the majority of students are likely to want frequently are purchased for the general library, and duplicates of those most often needed are either kept in the biological laboratory or are placed there from time to time when the subject they treat of is being studied; for instance, monographs on the various vegetable and animal types which undergraduates study in the course of their first year's work. The more important biological journals, in various languages, are taken regularly by the University, so that an advanced worker has, in a vacant half hour, only to walk a few steps to find the current periodical literature in his own subject. A list of the periodicals accessible to those working in Baltimore is given on p. 114.

Apart from the general University Library there is a special biological collection, consisting partly of books, pamphlets, &c., purchased in connection with special researches carried on in the Laboratory; the latter form a large part of the collection, as an effort is made to procure for any one engaged in a particular investigation all publications bearing on his work but not readily obtainable, as graduation theses, occasional publications from various continental laboratories, &c., &c. Like the physiological apparatus, the collection of books pertaining to Biology thus falls into two main groups: those apt to be needed for every day use, and those purchased for some specific end and representing some research, completed, in progress, or contemplated; no work is bought because it seems likely on vague general principles to become some day useful to somebody, but as soon as it is wanted it is if possible obtained.

In this connection, it is a pleasant duty to acknowledge the friendly help of Dr. John S. Billings and the other authorities of the Library of the Army Medical Museum in Washington, who have not only afforded every facility to those who have gone to Washington to consult works in that Library, but have sent to Baltimore, from time to time, out of their unrivalled store of physiological works, any which they possessed and which we have requested a loan of for some special purpose. Through their courtesy many otherwise unattainable treatises have been made available to us for study in the quiet of our own rooms, or for use in the Laboratory.

Publications.

In connection with its recognized duty in promoting research, the University almost necessarily assumed the function of publication, and has accordingly assisted, in one way or another, Journals of Mathematics, Chemistry, and Philology. In the case of Biology a special difficulty has to be met, since a large proportion of biological researches require for satisfactory presentation more or less numerous plates, the cost of which makes their publication comparatively expensive. Physiological articles have hitherto been provided for in the Journal of Physiology, edited by Dr. Michael Foster, F. R. S., of Cambridge, England, and of which Professor Martin is one of the American Associate Editors.

The publication of the morphological researches presented more difficulty, as they commonly require a greater number of plates and are therefore more difficult and expensive to produce; such articles have accordingly been somewhat scattered, according as editors would agree to take them. The scientific results of the Seaside Laboratory in 1878 were published by subscription of a number of citizens of Baltimore; other morphological papers have appeared in various journals, while others were published by the University in a series of "Studies from the Biological Laboratory," which also contains reprints of some of the articles by members of the University published elsewhere, as well as other biological articles by members of the University not previously presented to the scientific world.

In future, the Journal of Physiology, which is the only periodical in the English language devoted solely to the publication of original physiological research, will be published in America with the aid of the Johns Hopkins University, and be issued from it to subscribers. The "Studies from the Biological Laboratory" will also be continued to secure the publication of articles which would otherwise be delayed, and partly also to bring together in the form of collected reprints the researches yearly proceeding from the Laboratory and scattered in different periodicals.

Special Students.

Under this head may be included a number of persons, some graduates of a college and some not, who have desired to gain a knowledge of certain departments of Biology, without carrying on such prolonged study as is necessary to those who look forward to becoming specialists. The number of medical men, for example, who have entered for a course of instruction in Histology or Animal Physiology has been quite large, and each year several students from medical schools in the city have been admitted to study in the laboratory. In accordance with the general principle of the University, to be chary of its honors but liberal of its benefits, such persons, though not candidates for a degree, are willingly received when circumstances, such as the time which can be given to this work, shew that it is likely to be profitable.

A systematic course of instruction for students who have not matricated and who do not intend to take the B. A. degree has been thrown open to those who intend hereafter to study Medicine, and who can pass an entrance examination designed to shew whether they have a fair general education. The studies of this course extend through three years; in the second of these the student takes up (with certain other subjects) General Biology, and in the third, Animal Physiology and Histology, and Vertebrate Anatomy. So far at least as Biology is concerned, we believe the facilities thus offered to those who intend to study medicine, and who, for various reasons, are unable to take a full collegiate
course such as is requisite for attaining the B. A. degree, are of considerable importance. It practically extends the time occupied in medical studies, and gives the student a sound, if elementary, scientific education as a basis for his technical studies. Physiology in a medical school is, of necessity, nearly always "Human Physiology," which the experience of late years has taught us as unscientific, studied by itself, as the so-called "Physiological Chemistry." Medical Physiology should be taught on a broader basis of General Physiology, as Medical Chemistry on a previously acquired knowledge of General Chemistry; it is only then that the practical applications of physiological facts, which form the proper field of instruction in a medical school, are likely to be fully appreciated or intelligently retained.

**Classes for School Teachers, and Demonstrations to Medical Students.**

Efforts have also been made to extend instruction to persons who could not derive immediate benefit from the University work unless special arrangements were devised for them. In 1877, Professor Martin conducted a class for the Instruction in Physiology of School Teachers. The class met on twenty successive Saturdays from 10 A. M. to 2 P. M. Each meeting commenced with a lecture on the topic of the day's work, and the class then adjourned to the Laboratory for practical study. A syllabus of directions for practical work was drawn up and printed, and an attempt was made to give those attending a fair practical acquaintance with Physiological Anatomy and with Histology, and also to show them how to perform such physiological experiments as are suitable for demonstration in schools; a number of other facts in Physiology were demonstrated with the hope of giving a surer basis for intelligent instruction by the members of the class.

In 1878, Dr. Brooks conducted a similar "Teachers' Class" in Zoology, the members of which dissected under his supervision a number of typical Invertebrates; a printed syllabus of directions for dissecting the various animals studied was also drawn up for the use of the class.

**SCHEDULE OF THE BIOLOGICAL INSTRUCTION FOR UNDERGRADUATES.**

The regular courses in Biology for undergraduates have hitherto varied somewhat from year to year as the needs of students have become more manifest or the staff has been increased. As now organized the courses given annually are as follows; no great departure from this scheme may be expected in future, except as additions may be made on the appointment of teachers in subjects not yet represented.

**First Year's Studies.**

1. **General Biology.** Professor Martin. Thrice weekly, from the commencement of the academic year to the end of March.

2. **Embryology.** Professor Martin. Thrice weekly, from the commencement of April to the close of the academic year.

3. **Human and Comparative Osteology.** Dr. Brooks. Thrice weekly, from the beginning of October to the end of April.

**Second Year's Studies.**

4. **Animal Physiology and Histology; Elementary Class.** Professor Martin. Thrice weekly during the academic year. In future Dr. Sewall will take charge of this class.

5. **Zoology and Comparative Anatomy.** Dr. Brooks. Thrice weekly during the first six months of the academic year.

The Laboratory is open daily for practical instruction in connection with the above courses of lectures and recitations.
The following list contains the titles of all the formal courses of lectures which have been given in connection with the Biological Department up to the close of the past year. As will be seen many of the courses were annually repeated, as they formed a part of the regular undergraduate instruction; other more advanced lectures were given on varied topics from time to time as the needs of graduate students made it desirable, but most of the graduate instruction, being necessarily adapted to individuals engaged in special advanced work in some one limited direction, is given by means of daily counsel and by informal intercourse and discussion with the Instructors. In all cases, except the courses indicated as public lectures, the lectures are supplemented by daily, systematic, practical laboratory study, the lectures themselves being mainly designed to direct the reading and thought of the student, and to point out to him what are the important facts which he should verify for himself. The special topics of the more advanced lectures vary from year to year, but their general scope and range may be gathered from the list here given, and may be expected rather to be increased than diminished in future.

1876-77.

1. Animal Physiology. Professor Martin. Twice weekly, from October to April.
   This course was designed mainly for physicians and others who had already a general acquaintance with Human Physiology. The points that were main attention was given were, accordingly, recent physiological advances, as the vasomotor nerves, the physiology of secretion, the localisation of cerebral functions, etc.

   This course was intended to afford an educated audience the opportunity of hearing a critical discussion of such topics as the Origin of Species, Darwin's theory of Pangenesis, Instinct in Animals, etc.

3. The Anatomy of Invertebrate Animals. Dr. Brooks. Thrice weekly, from January to the end of the academic year.
   In this course, designed to meet the needs of graduate students, the affinities of the groups of Invertebrata, as indicated by their developmental history, were mainly considered. Those attending the lectures were presumed to have a fair knowledge of the anatomy of adult animal forms.

4. General Biology. Professor Martin and Dr. Brooks. Thrice weekly, during April and May, 1877.
   In this course the structure and physiology of a unicellular fungus, greenplant, and animal were studied; and several of the higher Fungi, Cryptogams, and Flowering Plants, and a typical Infusorian Coelenterate, Annullate, Molusc, and Vertebrate. The course was intended as an introduction to biology for those who had in earlier parts of the session gained some knowledge of physics and chemistry.

   In this course, designed for advanced students, the embryology of the bird was considered in reference to general vertebrate morphology.

1877-78.

6. Animal Physiology and Histology. Professor Martin. Thrice weekly, from early in October to the end of March.
   This course, planned for undergraduate students, was adapted to the requirements of those who had already learnt the rudiments of Animal Anatomy and Histology the previous year, (see course 4), and also how to use a microscope and to dissect.

7. Comparative Anatomy and Zoology. Dr. Brooks. Thrice weekly, from the beginning of October to the end of March.
   This course, like the preceding, was mainly designed for students who had followed the instruction in General Biology during the preceding academic year.

8. The Senses and the Brain, and their relation to Thought. Professor William James, of Harvard University. Ten public lectures.

   This course was a repetition of course 4.

10. Animal Embryology, with a special study of the development of the chick. Dr. Brooks. Eight lectures, in May.
   This covered the same ground as course 5, above.

11. Instruction in Physiology for School Teachers. Professor Martin. Twenty lectures, with laboratory work, on Saturdays from 10 A. M. to 2 P. M., commencing October 13.
   In this course the fundamental points of gross and microscopic structure, and the functions of the more important organs and mechanisms of the mammalian body were studied.

12. Chesapeake Zoological Laboratory, session of 1878. Dr. Brooks, Director in immediate charge. Open at Fort Wool, Va., from June 15 until the middle of August.

13. The Structure and Development of Bone and Tooth, with special reference to the cellular pathology. Dr. Christian Shuler, Fellow of the University. Six public lectures, designed for Physicians and Dentists, April, 1878.

1878-79.

14. General Biology. Professor Martin. Twenty lectures, delivered in common to a general audience and to students commencing their biological studies. Four times weekly, commencing September 26.
   The ground covered was practically the same as in course 4.

   This course, delivered to advanced students, was devoted to the Vertebrata.

   This course was designed to meet the needs of undergraduates who had successfully passed through the instruction in General Biology (course 14 above) and who desired especially to study Animal Morphology.

17. Animal Physiology and Histology, mainly with reference to the Human Body. Professor Martin. Twice weekly, from November 5 to the end of the academic year.
   A course for undergraduates, who, whether intending subsequently to become medical students or not, after taking the introductory course 14, wished especially to study Animal Physiology.

18. Human Osteology. Dr. Brooks. Twice weekly, from November 12 to the end of April.
   This course was designed for undergraduates as an introduction to Vertebrate Morphology, the human skeleton being selected as a starting point, as that from which the general terminology of Vertebrate Osteology has been adopted, and also as the most accurately known of all Vertebrate skeletons.
19. Instruction in Human Histology for Medical Students. Henry Sewall, S. B., Fellow of the University. Sixteen practical lessons in Microscopic Anatomy, on Wednesday and Saturday afternoons, commencing March 22.

20. The Physiology of Sensation. Professor Martin. Ten lectures, commencing September 30.


23. The Development of the Tissues. Professor Martin. Six lectures, commencing February 17.

The four preceding courses were planned to meet the wants of advanced students in the Laboratory, and each member of the class was presumed to have already a fair text-book knowledge of the subjects discussed.

24. The Elements of Embryology, Human and Comparative. Professor Martin and Dr. Brooks. Twice weekly, from April 18 to the end of the academic year.

25. Instruction in Zoology for School Teachers. Dr. Brooks. Fifteen lessons, with laboratory work, 10 A. M. to 2 P. M., on Saturdays, commencing November 16.


In this course, to which physicians and medical students in the city who were not members of the Johns Hopkins University were admitted, the fundamental facts in Mammalian Physiology were demonstrated.

27. Vegetable Morphology. Professor Farlow of Harvard University. Twenty-four lectures, commencing April 15.


29. Chesapeake Zoological Laboratory, session of 1879. Dr. Brooks, Director in immediate charge; Dr. S. F. Clarke, Fellow of the Johns Hopkins University, Assistant. Opened at Crisfield and Fort Wool from June 25 until September 13.

30. General Biology. Professor Martin. Thrice weekly, from the commencement of the academic year to the end of April.

In this course, which is an extension of course 4, undergraduate students studied several additional plants, and a type from each class, instead of each sub-kingdom, of animals.

31. Human and Comparative Osteology. Dr. Brooks. Twice weekly, from the commencement of the academic year to April.

An introduction to Vertebrate Morphology for undergraduate students.

32. The Physiology of the Senses. Professor Martin. Twice weekly, from the beginning of October to April.

In this course, designed for advanced students of Physiology already acquainted with the fundamental facts in the topics considered, more than three-fourths of the lectures were devoted to the Sense of Sight, as affording a specially available theme for the general discussion and illustration of the Physiology of Sensation. In future years other senses will be selected for the same extended treatment.

33. Animal Morphology. Dr. Brooks. Lectures or recitations four times weekly, from the commencement of the academic year to the end of April.

In this course, adapted to advanced students, the Invertebrates were mainly considered.

34. Vertebrate Embryology. Professor Martin. Twice weekly, from April to the close of the academic year.

This course was, in the main, a repetition of course 5, above.

35 The Structure and Development of the Crab and Oyster. Dr. Brooks. Four public lectures, in February.


This course was essentially a repetition of that described above, as number 26.

37. Instruction in Microscopic Anatomy for Medical Students. Dr. C. Sihler, Assistant in Biology. Eighteen practical lessons, commencing March 6.

38. The Chesapeake Zoological Laboratory, session of 1880. Dr. Brooks, Director in immediate charge. Open at Beaufort, N. C., for advanced study, from the beginning of May until September 15.

39. Elementary Summer School for the Study of Marine Zoology. Dr. S. F. Clarke, Former Fellow and Assistant in Biology of the Johns Hopkins University, in charge. Opened at Fort Wool, Va., July 15, for a session of six weeks.

1880-81.

The following list gives the courses of lectures which were commenced in 1880, and also those which are, so far, planned for that portion of the academic year which falls within 1881.

40. General Biology. Professor Martin. Two lectures and a recitation weekly, from the commencement of the academic year to the end of March.

Mr. Sedgwick, Ph. B., Yale, formerly Fellow of the Johns Hopkins University and now Assistant in Biology, directs the details of the Laboratory work and conducts the recitations.

The course is in essentials a repetition of that above.

41. Animal Physiology. Professor Martin. Two lectures and a recitation weekly, throughout the academic year.

Dr. Sewall, Associate in Biology and Assistant Professor of Physiology, takes charge of the weekly recitation and supervises the daily laboratory work. This course is designed for students in the second year of their biological studies.

42. Human and Comparative Osteology. Dr. Brooks. Five lectures or recitations weekly, from December 1 to the end of March.

43. The Construction, Theory, and Employment of Physiological Instruments. Dr. Sewall. Twenty lectures illustrated by the apparatus belonging to the Biological Laboratory, commencing November 1.

In this course the method of using the various instruments employed in physiological experiment is illustrated; the limits of error are discussed, and an account of the main results which have been arrived at by the use of various instruments is given.

Before the close of the session, Professor Martin will lecture on Embryology, Dr. Brooks will give a short course on Anthropology, August Schimper, Ph. D., Strassburg, Fellow of the University, will lecture on Vegetable Physiology, and Mr. Sedgwick, Ph. B., Yale, Assistant in Biology, will conduct an elementary class in Systematic and Structural Botany in connection with the Naturalists' Field Club.
A marine station or seaside dependency of the Biological Department of the University has been open for advanced study and research each summer since 1878, under the immediate charge of Dr. W. K. Brooks, Associate of the University and Assistant Professor of Comparative Anatomy.

**Session of 1878.**

The Seaside Laboratory was opened on June 24th at Fort Wool, in Hampton Roads, Va., for a session of eight weeks. The party consisted of

- W. K. Brooks, Ph. D., Director.
- H. Sewall, S. B., Assistant in Biology, Johns Hopkins University.
- C. Shipley, M. D., Fellow, Johns Hopkins University.
- August Schmidt, Teacher of Natural Science, Baltimore.
- N. B. Webster, Principal, Webster Military Academy, Norfolk, Va.
- T. B. Webster, Norfolk, Va.

The above remained during the whole session; P. R. Uhler, Associate of the University and President of the Maryland Academy of Sciences, and W. D. Booker, M. D., were present for a part of the time.

The fauna of Hampton Roads proved to be very interesting, and it not only afforded a good supply of material for elementary work, which was preserved for class use in Baltimore during the ensuing winter, but furnished ample opportunities for original investigation.

Among the interesting forms of life which were most abundant the following may be mentioned: Sagitta, Appendicularia, Tornaria and Balanoglossus, Pilidium, Actinotrocha and other interesting trochæ larveæ, Squilla, Porcellana, Amphioxus and Lmngula in all stages of development, and many others of great scientific interest.

An abundant supply of material for work upon the adult structure and the development of the Sponges, Hydroids, Medusæ, Ctenophora, Gephyraeans, Annelidæ, Crustacea, Tunicata, Polyzoa, Brachiopods, Lamellibranches, Gasteropods and lower Vertebrates was within easy reach.

A number of papers, giving an account of the scientific work of the party, were published together as "Scientific Results of the Chesapeake Zoological Laboratory, 1878," forming part 3 of Vol. I of "Studies from the Biological Laboratory," under which head a list of them will be found. Two illustrated papers on the Structure and Habits of Amphioxus were also published by H. J. Rice in the American Naturalist.

The experience gained in 1878 showed that some of those then received as students were hardly fitted to carry on the advanced work for which the Marine Laboratory was designed; hence somewhat more care has since been exercised in selection in order to ensure that those received are qualified to profit by the opportunities offered.

**Session of 1879.**

This year the University cooperated with Major W. B. Ferguson of the Maryland Fish Commission, in order to undertake the study of the oyster beds of Tangier Sound on the eastern side of the Chesapeake. The Laboratory was accordingly opened on June 25th at Crisfield, on three barges provided by the Maryland Fish Commission and with the advantage of the use of the Fish Commission yacht, the Lookout, for dredging purposes. Crisfield, while excellent for the special study of the oyster beds, proved a disadvantageous locality in other respects, and the Laboratory, on August 8th, removed to its former quarters at Fort Wool, where the session was continued until September 15th.

The party consisted of

- W. K. Brooks, Ph. D., Director.
- S. F. Clarke, Ph. D., Fellow, Johns Hopkins University, Assistant.
- B. W. Barton, M. D., Baltimore.
- Emil Bessels, M. D., Smithsonian Institution.
- H. C. Evans, M. D., Academy of Natural Sciences, Philadelphia.
- K. Mitsukuri, Ph. B., Graduate Student, Johns Hopkins University.
- R. A. Nunn, Professor of Biology, Wellesley College.
- H. J. Rice, S. B., late Fellow, Johns Hopkins University.
- August Schmidt, Baltimore.
- C. Shipley, M. D., Fellow, Johns Hopkins University.
- E. B. Wilson, Ph. B., Fellow, Johns Hopkins University.

Among the subjects studied by the members of the party were the development and propagation of the Oyster; the structure and growth of Hydroids; the development of the Crabs; the embryology of the Ctenophore; the life history of the Squid; and the metamorphosis of Actinotrocha.

The fourth part of Vol. I of the "Studies from the Biological Laboratory," with 13 plates, is made up of two papers resulting from the work of this session of the Marine Laboratory; another paper (The Development of the Squid) has been printed, with illustrations, in the Memoirs of the Boston Society of Natural History, and other papers will soon be published.

**Session of 1880.**

At the beginning of the third session the Marine Laboratory was provided with a steam launch, which was built for the purpose at Bristol, R. I.; and arrangements were made to spend a much longer period at the seaside. The session was opened on April 23d at Beaufort, N. C., and closed on September 30th.

A house standing close to the water was hired, and fitted with working accommodations for six investigators; and the facilities which it afforded were used by the following persons:

- W. K. Brooks, Ph. D., Director.
- K. Mitsukuri, Ph. B., Fellow, Johns Hopkins University.
- E. B. Wilson, Ph. B., Fellow, Johns Hopkins University.
- W. K. Brooks, Ph. D., Associate of the University and Assistant Professor of Comparative Anatomy.

The faunal region of Beaufort was selected as being the nearest accessible town, south of Baltimore, favorably situated for marine zoological study, and its fauna was found to be unusually rich and varied; almost every thing which was found at Fort Wool was met with here, as well as very many interesting forms which do not occur further north.

Close to the town there are large sand bars, exposed at low tide, and abounding in animal life. These yielded an abundant supply of Amphioxus, Renilla, Limulus, Balanoglossus, Sea Urchins, and a great variety of Mollusces and Crustacea. The mud flats furnished another fauna and yielded a great variety of Annelidæ, Gephyraeans, Polyplacophora, Ophiuridæ, Holothuridæ and Echinidæ, and a series of species of Mollusces and Crustaceæ different from those found on the sand bars. The large salt marshes gave a third fauna, and a short distance inland large
swamps of brackish and fresh water furnished still other conditions and forms of life. As the town is situated at the point where Gore Sound connects Pamlico Sound with Bogue Sound, a large sheet of land-locked water was within easy reach, and this furnished a collecting and dredging ground abundantly in Corals, Gorgonide, Ascidians, Star Fishes, Sea Urchins, Ophiurids, and still another set of Molluscs and Crustacea.

The stone breakwaters at Fort Macon and the wharves at Morehead City and Beaufort afford a proper habitat for sedentary animals, and yielded a rich supply of Hydroids, Corals, Ascidians, Sea Anemones, Sponges, Cirripedias, &c. The ocean beach, within a short distance of the town, furnished still another fauna; and a good locality for ocean dredging could be reached by a sail of three miles from the laboratory.

The greatest attraction of the locality is the richness of its pelagic fauna. The Gulf Stream is constantly sweeping oceanic animals along the North Carolina coast, and as the tide flows through Beaufort Inlet to the Sounds these floating animals are carried with it. Such oceanic animals as Porpita and Physalia were frequently thrown, uninjured and in perfect health, upon the beach within twenty feet of the laboratory.

These attractions, together with the mild and uniform oceanic climate which enables the student to work with perfect comfort during the hottest months of summer, fully justified the selection of this locality.

During the summer the following abstracts of the more important results of the season’s work were published in this country and in Germany, and more detailed accounts are now in preparation.


The Early Stages of Renilla, by E. B. Wilson, *Zoologischer Anzeiger.*

**Announcement for the Session of 1881.**

The fourth session of the laboratory will commence at Beaufort, May 2, and will continue until the end of August. Dr. W. K. Brooks, Associate in Biology and Assistant Professor of Comparative Anatomy, will be in immediate charge as Director.

The laboratory is provided with a steam launch; small boats, nets, dredges, aquaria, microscopes, reagents, and a small reference library are also supplied by the University. For their use, those admitted to the Laboratory will be charged a fee of $25. The Marine Laboratory is designed for advanced students and for those qualified to carry on original investigation. Members of this University will have the first claim to accommodation, but a few other naturalists can probably be also received. Persons desiring to join the party are requested to send applications to Dr. H. Newell Martin, Professor of Biology, and, if not holding public positions which indicate the possession of an adequate knowledge of Zoology, to supplement the application by such a statement as to previous work or training as will make it possible to decide whether the applicant is qualified to profit by the opportunities offered. Suitable candidates will be accepted so far as the accommodations of the Laboratory permit, and tickets of admission will be issued on payment of the fee to the Treasurer of the University in Baltimore. No definite courses of instruction will be given, as the persons received will be presumed to have sufficient knowledge to carry on their studies without such aid; Dr. Brooks will, however, exercise a general supervision, and control and direct the daily work of the Laboratory.

**ELEMENTARY SEASIDE SCHOOL.**

**Announcement for 1881.**

During about six weeks of the coming summer, commencing early in July, there will be an elementary class in Marine Zoology in connection with the station at Beaufort; daily lectures will be given and arrangements made for systematic work in the laboratory. On every day when the weather is favorable there will be a dredging or collecting expedition, in which part of the elementary class will be allowed to join.

The Director of the Chesapeake Zoological Laboratory for advanced students will exercise personal supervision of the work of the elementary class, and will give a course of lectures on General Zoology, but the students will be under the more immediate guidance of Dr. S. F. Clarke, formerly Fellow of the University and subsequently Assistant in Biology, who will lecture daily upon the structure and habits of marine animals, and will superintend the work in the laboratory.

Applicants for admission to the elementary class will be required to satisfy Professor Martin, by examination or otherwise, that they are qualified for admission into the Biological Department of the University, and they will be required to attend the whole course, and to devote themselves to study, although, bearing in mind that most of the students will probably have just finished a year’s collegiate study elsewhere, the work in the laboratory will be so arranged as to leave abundant time for out-door life, and for the enjoyment of fishing, boating, and bathing.

The fee for instruction and for the use of apparatus and of specimens for laboratory work will be $25 for the course of five weeks, payable to the Treasurer of the University in Baltimore; and his receipt will serve as a ticket of admission to the class at the laboratory.

Should any of the members of this class be found qualified for special work in the laboratory for advanced students they will be allowed to study there during the rest of the season without extra charge.

Board and lodging can be obtained in the town of Beaufort, within a short distance of the laboratory, for from $20 to $30 a month. The diversified fauna of this locality, together with its mild and uniform climate, renders it a desirable place for study during the hot months of summer.
LIST OF BIOLOGICAL PAPERS,
Published by Members of the University.
September, 1876, to December, 1880.

Only articles published during the connection of the author with the Biological Department or based on work carried on in it are here included.

By I. E. Atkinson, M. D.
The Botanical Relations of Tricophyton tonsurans. (New York Medical Journal, December, 1878; Studies from the Biological Laboratory, Vol. 1, pt. 1, 1879, pp. 15.)

By W. D. Booker, M. D. See H. N. Martin.

By W. K. Brooks, Ph. D.
A Remarkable Life-History. (American Naturalist, November, 1876, pp. 16.)

A Provisional Hypothesis of Pangenesis. (American Naturalist, March, 1877, pp. 4.)

Parthenogenesis in Vertebrates and Molluscs. (American Naturalist, October, 1877, pp. 2.)

Preliminary Observations upon the Development of the Marine Proso-branchniæ Gasteropoda. (Studies from the Biological Laboratory, Vol. 1, pt. 1, 1879, pp. 22; 1 plate).

The Development of Lingula and the Systematic Position of the Branchiopoda. (Studies from the Biological Laboratory, Vol. 1, pt. 3, 1879, pp. 78; 6 plates).

The Larval Stages of Squilla Empusa. (Studies from the Biological Laboratory, Vol. 1, pt. 6, 1879, pp. 28; 5 plates).

Observations upon the Early Stages in the Development of the Fresh Water Pulmonates. (Studies from the Biological Laboratory, Vol. 1, pt. 2, 1880, pp. 32; 4 plates).

The Development of the Digestive Tract in Molluscs. (Proceedings, Boston Society of Natural History, 1879, Vol. XX, pp. 4.)


The Development of the American Oyster. (Report of the Maryland Fish Commission, 1880; Studies from the Biological Laboratory, Vol. 1, pt. 4, 1880, pp. 101; 10 plates).

The Acquisition and Loss of a Food Yolk in Molluscan Eggs. (Studies from the Biological Laboratory, Vol. 1, pt. 4, 1880, pp. 10; 1 plate).

The Development of the Cephalopoda and the Homology of the Cephalopod Foot. (American Journal of Science, 1880, pp. 3.)

The Rhythmic Character of Segmentation. (American Journal of Science, 1880.)

Budding in Free Mussels. (American Naturalist, 1880.)

Embryology and Metamorphosis of Lucifer. (Zöologischer Anzeiger, 1880, pp. 3.)

The Early Stages of the Squid. (Memorial Volume, Boston Society of Natural History, 1880, pp. 20; 4 plates).

By S. F. Clarke, Ph. D.
Hydroids of Alaska. (Academy of Natural Sciences, Philadelphia, 1878; Smithsonian Institution, 1878.)


By Walter Faxon, Ph. D.
Description of Lucifer typus. (Studies from the Biological Laboratory, Vol. 1, pt. 3, 1879, pp. 7; 1 plate.) Paper based on specimens forwarded to Professor Faxon from the Marine Laboratory.

By E. M. Hartwell, A. M.
The Legal Status of Anatomical Science. (Journal of Social Science, 1880.)

American Anatomy Acts; six articles. (Boston Medical and Surgical Journal, 1880.)

The Earliest English and American Medical Acts. (Boston Medical and Surgical Journal, 1880.)

— also see H. N. Martin.

By William Lee, M. D.
The Effect of Stimulation on an Excised Nerve. (New York Medical Record, 1877, pp. 9.)

By Professor Martin.
The Normal Respiratory Movements of the Frog and the Influence upon its Respiratory Centre of Stimulation of the Optic Lobes. (Journal of Physiology, 1878; Studies from the Biological Laboratory, Vol. 1, pt. 1, 1879, pp. 24; 1 plate).

A self-feeding Chronograph Pen. (Studies from the Biological Laboratory, Vol. 1, pt. 2, 1880, pp. 5; with wood cut).

By Professor Martin and W. D. Booker, M. D.
The Influence of Stimulation of the Midbrain upon the Respiratory Rhythm of the Mammal. (Journal of Physiology, 1878; Studies from the Biological Laboratory, Vol. 1, pt. 1, 1879, pp. 7; 1 plate).

By Professor Martin and E. M. Hartwell, A. M.

By Isaac Ott, M. D.
Sweat-Centres. The Action of Muscarin and Atropin on them. (Journal of Physiology, 1878, pp. 5.)


By H. J. Rice, S. B.
Observations upon the Hatching, Variation, and Development of the Raritan River Smelt, Osmerus eperlanus. (Report of Maryland Fish Commission, 1878.)

Notes upon the Development of the Shad, Alosa sapidissima. (Report of Maryland Fish Commission, 1878.)


By W. T. Sedgwick, Ph. B.
The Influence of Quinine upon the Reflex-excitability of the Spinal Cord. (Journal of Physiology, 1880, pp. 16.)

By Henry Sewall, Ph. D.
Development and Regeneration of Gastric Glandular Epithelium during Fetal Life and after Birth. (Journal of Physiology, 1878; Studies from the Biological Laboratory, Vol. 1, pt. 3, 1879, pp. 34; 1 plate).

On the effect of Two Successing Stimuli upon Muscular Contraction. (Journal of Physiology, 1879; Studies from the Biological Laboratory, Vol. 1, pt. 1, 1880, pp. 27; 1 plate).

By Christian Sheiler, M. D.
On the so-called Heat-Dyspnoea. (Journal of Physiology, 1879; Studies from the Biological Laboratory, Vol. 1, pt. 2, 1883, pp. 12.)

Some Further Observations on Heat-Dyspnoea. (Journal of Physiology, 1880; Studies from the Biological Laboratory, Vol. 1, pt. 2, 1880, pp. 10.)

By P. R. Uhler.
List of Animals observed at Fort Wool, Va. (Studies from the Biological Laboratory, Vol. 1, pt. 3, 1879, pp. 18.)

By N. B. Webster.
Partial List of the Land Plants found at Fort Wool, Va. (Studies from the Biological Laboratory, Vol. 1, pt. 3, 1879, pp. 2.)

By E. B. Wilson, Ph. B.
Preliminary Abstract of Observations on the Early Stages of some Polychaetous Annelides. (Zoologischer Anzeiger, 1880, pp. 2.)

Notes on the Early Stages of some Polychaetous Annelides. (American Journal of Science, 1883, pp. 7.)

The Metamorphosis of Actinothoe. (American Association, Boston Meeting, 1885; abstract in American Naturalist, 1888.)

The Early Stages of Renilla. (American Journal of Science, 1880, pp. 3; 1 plate.)
LIST OF PERIODICALS.

The following list contains an enumeration of the principal periodicals, devoted either wholly or partially to the publication of articles on biological topics, which are taken by the Library of the Johns Hopkins University, the Library of the Peabody Institute, and by the Medical and Chirurgical Faculty of Maryland; a perusal of it will shew that nearly all important periodical biological literature is readily accessible to Baltimore students.

The publications of learned societies are usually given under the name of the place where the meetings are held. The University Library is designated by H. The Peabody Library is designated by P. The Medical Library is designated by M. A complete set is indicated by an asterisk; as H*, P*, etc.

American association for the advancement of sci.: Proceedings. Salem, &c. H. P.*
American entomologist; Transactions. Philadelphia. P.*
American astronomical society; Transactions. New York. H.*
American astronomical society; Transactions. Boston. H.*
American journal of ophthalmology, Philadelphia. M.*
American journal of surgery, New York. H.*
American journal of insanity. Utica. M.*
American journal of medical sciences. Philadelphia. M.*
American journal of microscopy, New York. M.*
American journal of obstetrics. New York. M.*
Annals and magazine of natural history. London. P.*
Annals scientifiques: (Figuier). Paris H.*
Annual record of science and industry. New York. H. P.*
Archiv für anatomi und physiologie. (Braune u. Reymond.) Leipzig. H.*
Architecture and building. New Orleans. M.*
Archives de biologie, Gand et Leipzign. M.*
Archives de physiologie: Moscow. H.*
Archives de zoologie: Memoires. H.*
Archives de zoologie expirimentelle et générale. Paris. M.*
Archives of dermatology. New York. M.*
Archives of ophthalmology, New York. M.*
Archives of ology. New York. M.*
Archivio per le scienze mediche. Terino. H.*
Berlin. Königliche akad. d. wissenschaften: Monatsberichte. H.*
Berliner klinische wochenschrift. M.*
Botanical magazine. (Curtis.) London. P.*
Botanical magazine. (Pfeiffer.) London. M.*
Botanische zeitung. Leipzig. H.*
Britann. London. H.*
Breithaupt's retrospect. New York. M.*
British medical and surgical journal. M.*
British medical journal. London. H.*
Brussels. Académie royale (belge) des sciences: Bulletins. H. P.*
Buffalo. Academy of science: Bulletin. H.*
California academy of natural science; Proceedings. San Francisco. P.*
Canadian national and quarterly journal of science. M.*
Centralblatt für die medizinischen wissenschaften. Berlin. H.*
Chicago. Academy of science: Transactions. M.*
Chicago medical and surgical journal. M.*
Chicago medical journal and examiner. M.*
Cincinnati lancet and clinic. M.*
Deutsche akademie der naturforscher: Nova acta. H.*
Dublin. Royal Irish academy: Transactions. H.*
Dublin medical journal. H.*
Edinburgh. Royal society: Transactions. M.*
Edinburgh medical journal. M.*
Entomological society: Transactions. H.*
Entomological society: Transactions. M.*
France. Government publications. P.*
Göttingen. Königliche gesellschaft der wissenschaften: Nachrichten. H.*
Guilford's medical journal. New York. M.*
Gazette des hôpitaux. M.*
Gazette hebdomadaire de médecine et de chirurgie. Paris. M.*
Great Britain and Ireland. Government publications. H.*
Half-yearly compeund of medical science. Philadelphia. M.*
Heidelberg. Untersuch a d. physiolog. inst. M.*
Independent practitioner. Baltimore. M.*
Indic medi. New York. M.*
Institut de France. Académie de sciences: Comptes rendus. M.*
Jahrbuch für wissenschaftliche botanik. Leipzig. H.
Jahresber. über die fortsch. der anat. und physiol. (Hofmann u. Schwabe.) Leipzig, (Contu. of Bericht. Hensle-Meissner.) H.*
Jahresber. über die fortschritte in d. physikal. und chemisch. Wissenschaften. H.*
Jahresber. über die fortschritte in d. medizin. Wissenschaften. H.*
Jenaische zeitschrif für naturwissenschaft. H.*
Journal de l'anatomie et physiologie. Paris. H.*
Journal of anatomy and physiology, Cambridge and London. H.*
Journal of the Royal medical and surgical association. London. H.*
Journal of nervous and mental disease. Chicago. M.*
Journal of physiology. Cambridge and Baltimore. M.*
Kosmos. Leipzig. P.*
Lancet. London. H.*
Leonard's illustrated medical journal. Detroit. M.*
Leips. Medizinische dierkundige verein: Tijdschriften. H.*
Lieber. Socie detached des sciences: Mémoires. H.*
London. Anthropological institute: Journal. P.*
Chirurgische society: Transactions. M.*
Pathological society: Transactions. M.*
Rheumatic society: Publications. M.*
Royal society: Philosophical transactions. P.*
St. Bartholomew's hospital reports. Transactions. P.*
St. Bartholomew's hospital reports. M.*
Zoological society: Transactions. P.*
London medical record. M.*
Maryland. Medical and chirurgical faculty: Transactions. M.*
Maryland medical journal. Baltimore. M.*
Medical advance. Cincinnati. M.*
Medical and surgical reporter. Philadelphia. M.*
Medical gazette. New York. M.*
Medical news and abstract. Philadelphia. M.*
Medical record. New York. M.*
Medical summary. Lansdale, Pa. M.*
Medical times and gazette. London. M.*
Milan. Belelto Lombarci e sciencie e lettere. Bencidocci. M.*
Monthly microscopic journal. London. H.*
Morphologisches Jahrbuch. Leipzig. M.*
Museum d'hist. nat. Archives, (now Novelles archives.) Paris. M.*
National board of health: Bulletins. Washington. M.*
National board of health: Bulletins. Washington. H.*
New remedies. New York. M.*
New York. Academy of sciences: Annuals. P.*
Anthropological institute: Journal. P.*
New York medical journal. M.*
Niederländisches archiv für zoologie. Leiden and Leipzig. H.*
Paris. École normale supérieure: Annales. H.*
Practitioner. London. M.*
Practitioner. London. P.*
Practitioner. London. M.*
Popular science monthly. New York. H.*
Popular science review. London. H.*
Philadelphia. M.*
Philadelphia medical times. H.*
Philsopical society: Transactions. P.*
Popular science monthly. New York. H.*
Popular science monthly. New York. M.*
Practitioner. London. M.*
THE JOURNAL OF PHYSIOLOGY.

Edited by Dr. MICHAEL FOSTER, F. R. S., of Trinity College, Cambridge, England.

With the cooperation in England of Prof. A. Gamgee, F. R. S., Owens College, Manchester; Prof. W. Rutherford, F. R. S., The University of Edinburgh; Prof. J. B. Sanderson, F. R. S., University College, London.

And in America of Prof. H. P. Bowditch, Harvard Medical School, Boston; Prof. H. N. Martin, Johns Hopkins University, Baltimore; Prof. H. C. Wood, University of Pennsylvania, Philadelphia.

This Journal, which is the only one in the English language devoted solely to the publication of original physiological articles, will in future be published in America with the aid of the Johns Hopkins University.

It is issued in numbers which appear not at rigidly fixed times but at intervals, varying from two to three months, determined by the supply of material. Six numbers, in from four to six parts, form a volume of about five hundred pages. By this method of publication a high standard of excellence is maintained, as there is no necessity to accept inferior matter which may come to hand, so as to fill up a number by a given date. As a rule the issue of a volume covers about a year.

A special feature of the Journal is a list of titles of books and papers on subjects of physiological interest which appears in each number, and which is endeavored to make complete for all languages. This list is reprinted in a separate form at the end of each volume and given to each subscriber. A worker, away from centres of physiological activity, is thus enabled to learn quickly what others are doing in reference to the particular topic he may be interested in; while the classified reprints form a complete physiological bibliography for future reference.

The subscription price is $5 per volume when supplied direct to subscribers; after the completion of the present volume no reduction will be made to the trade. American subscriptions should be sent to Professor H. Newell Martin, Johns Hopkins University.

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Priestley, J. An Account of the Anatomy and Physiology of Batrachian Lymph-Hearts (mainly Bibliographical).</td>
</tr>
<tr>
<td>Trotter, C. On &quot;Von Kries's Law.&quot;</td>
</tr>
<tr>
<td>Sterling, W. On Hyperplasia of the Mucous Membrane of the Urethra.</td>
</tr>
<tr>
<td>Gaskell, W. H. Preliminary Note of Further Investigations upon the Vasomotor Nerve System.</td>
</tr>
<tr>
<td>List of Titles of Books and Papers of Physiological Interest, published since Dec. 1887.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contents of Vol. I, Nos. 2 and 3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Köhne, W. assisted by Ayres, W. C. On the Stable Colors of the Retina.</td>
</tr>
<tr>
<td>North, W. On the Effect of Stimulation of the Optic Nerve on the Respirations of the Frog.</td>
</tr>
<tr>
<td>Kühne, W., Addition to the Article &quot;On the Stable Colors of the Retina.&quot;</td>
</tr>
<tr>
<td>Ott, Isaac and Field, G. H. Sweat-Centres: the Effect of Mascarin and Atropin on them.</td>
</tr>
<tr>
<td>KUHm, W. An Account of Two Experiments illustrating the Effects of Starvation, with and without Severe Labor, on the Elimination of Urine from the Body.</td>
</tr>
<tr>
<td>Kühne, W., Addition to the Article &quot;On the Stable Colors of the Retina.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contents of Vol. I, Nos. 4 and 5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nunn, E. A. The Structural Changes in the Epithelium of the Frog's Intestinal Canal.</td>
</tr>
<tr>
<td>Downes, G. F. On the Structural Changes which are produced in the Nervous System of Frogs by the Influence of the Salts of Vanadium and Antimony.</td>
</tr>
<tr>
<td>Walcott, G. L. The Function of the Epiglottis in Deglutition and Phonation.</td>
</tr>
<tr>
<td>Sewall, H. The Evolution and Development of the Gastric Glandular Epithelium during Fetal Life and after Birth.</td>
</tr>
<tr>
<td>Langley, J. N. On the Physiology of the Salivary Secretion.</td>
</tr>
<tr>
<td>Martin, H. Newell, and Booke, W. D. The Influence of Stimulation of the Mittelschmerz upon the Respiratory Rhythm of the Mammal.</td>
</tr>
<tr>
<td>Kroese, H., and Sterling, W. On the so-called &quot;Initial Contraction.&quot;</td>
</tr>
</tbody>
</table>

| List of Titles of Books and Papers of Physiological Interest, published since the appearance of Nos. 2 and 3. |

| List of Titles of Books and Papers of Physiological Interest, published since the appearance of No. 1. |
Preliminary Courses of Instruction for those who intend, at a later day, to begin the study of Medicine.

I. COLLEGIATE COURSE.

To obtain the degree of Bachelor of Arts in the Johns Hopkins University, a student must, first, pass the matriculation examination, and secondly, pursue at least five courses of study, selected from those provided by the University, and pass satisfactory examinations in them. Of the five courses required, two must be what are known as "major courses," i.e. the examination test will call for so much knowledge as an ordinary student (commencing with the training implied by his passing the matriculation examination) could acquire in about two years' work; the other three courses demanded are "minor courses," requiring one year's fair work for their completion. On an average, about three years' study after matriculation will be necessary for graduation, but candidates unusually well prepared at the beginning or of more than common ability, may take the degree in less time; while, on the other hand, those who so wish may extend their studies over a longer period.

Among these collegiate courses leading to the B. A. degree is one especially recommended to those who intend hereafter to study Medicine. This is so planned as to give those students who follow it a liberal education equivalent to that afforded by the other courses leading to the same degree. The principal studies in this course are Physics, Chemistry, and Biology, since it is especially desirable that this class of students should enjoy the resources for scientific instruction to be found in an endowed university with well equipped laboratories. Below is a summary of the complete course; the order in which the studies are there allotted, definite ones to each year, is that which is recommended, and which will usually be insisted upon, by the University authorities.

Graduates of a college in good repute are admitted to the course without any entrance examination, and may devote their attention especially to the scientific subjects.

Matriculation.

The examinations for matriculation take place twice yearly, at the beginning of June, and in the latter part of September.

Informal preliminary examinations may be held from time to time, by mutual agreement between the candidates and the examiners, for the purpose of ascertaining whether a student should be encouraged to present himself for the matriculation examination, and of giving him counsel as to the progress of his studies. To persons at a distance blank forms of application will be forwarded, upon the return of which, properly filled out, the candidates will be advised as to the expediency of their coming to Baltimore.

The special requirements for matriculation are as follows:

**Latin.** Grammar, Prosody and Composition; Caesar, 5 books; Ovid, 2000 verses (600 elegies); Virgil, Aenid, 6 books, and Eclogues; Cæsar, 7 orations; Livy, 1 book; Horace, Odes, 2 books.

**Greek.** Grammar, Prosody and Composition; Xenophon, Anabasis, 4 books; Homer, Iliad, 4 books; Herodotus, 1 book; any one drama.

The accurate reading at sight of passages previously unseen may render unnecessary the examination in the books above specified.

**Mathematics.** Arithmetic, including the Metric System; Algebra, Todhunter, 38 chapters; Geometry, plane and solid, Chauvenet; Plane Geometry, Chauvenet, 8 chapters; Analytic Geometry, Straight Line and Circle in rectangular coordinates, Salmon (Conic Sections) or Howison.

The subjects named, in both Mathematics and Language, merely indicate the range of the examination. Equivalents are accepted.

**German and French.** Candidates who intend to graduate through this course may offer French and German instead of Greek. They will be expected to display a knowledge of the elements of the grammar of those languages, and to translate at sight passages of ordinary French and German prose.

**English.** All candidates for admission will be expected to satisfy the authorities that, in addition to the studies in Mathematics and Language required for admission, they have been well trained in the ordinary English branches, including the use of the English Language, Geography, and the History of the United States.

**Natural Science.** Each candidate for admission must offer for examination some branch of Natural Science. Physical Geography is recommended as within the reach of all. An elementary acquaintance with Botany, Zoology, or Natural Philosophy will be accepted as a substitute.

Summary of the Course.

**First Year's Studies.**

1. Physics.
2. Chemistry.
3. German.*
4. Drawing.

**Second Year's Studies.**

1. Chemistry.
2. General Biology (Elements of Botany, Zoology, and Embryology).
3. French.*

**Third Year's Studies.**

1. Comparative Anatomy.
2. Physiology.
3. Any one of the minor courses for the B. A. degree. Mathematics, Logic and Psychology, and the English Language and Literature, are especially recommended to students if they have not already taken those subjects as substitutes for a minor course in French or German.

**Additional Studies.**

Besides the regular work in recitation-room or laboratory, students have the opportunity of attending in the University a large number of lectures on literary and scientific subjects. While attendance on these will not always be required, and the results of listening to them will not necessarily be scrutinized by examination, it is believed that they will furnish to the earnest student, while his time and care are chiefly given to the prosecution of his strictly collegiate work, a valuable opportunity for enlarging his general culture.

*Candidates who have shown at the matriculation examination that they can read ordinary French or German prose, may substitute for those subjects any of the remaining minor courses leading to the B. A. degree.*
Explanation of the Course.

**Physics.** The course in Physics is the regular minor course. It includes three recitations, two lectures, and one exercise in the Physical Laboratory, weekly, through a year.

Elementary Mechanics will be studied during the first portion of the year; then will follow, in the order named, the study of the Physical Properties of Matter, Theory of Undulations, Acoustics, Heat, Magnetism, Electricity, and Light.

The lectures have as their aim the elucidation, by means of experimental demonstrations, of the subjects pursued by the class.

One morning of each week will be assigned for the work in the laboratory. This work will be selected with two principal ends in view: First, to give the student a clearer insight into the subjects studied, serving as a test of progress both to teacher and learner; and, Second, to enable him to acquire a familiarity with the use of apparatus. The manner of conducting the exercise will be as follows: with the enunciation of a problem, each student will receive the apparatus necessary for its solution, and will be required to make the series of observations which, with their discussion and reduction, he is to submit to his instructor. These results will then be criticised and returned. Those who are aiming at the profession of medicine will thus grow familiar with physical instruments and methods. Of the phenomena presented by living things, as gathered from the detailed study of a number of typical plants, and of a specimen from each of the main groups of the animal kingdom. The embryonic development of the chick is also studied in detail. In this course beginners are taught how to dissect and observe animal structures. On the other hand, microscopic observation is usually not included. The student who desires special knowledge of the structure of plant tissues or of animal organisms should pursue this work through the study of Comparative Anatomy instead.)

The course is designed to give the student, in the first place, a knowledge of the laws of life in general, whether exhibited in animals or plants; and secondly, a special knowledge of Mammalian Anatomy and Comparative Anatomy—In this course the student is described, and also that from which the greater part of the nomenclature of comparative osteology is derived, the student commences with it, and then proceeds to the examination of a number of typical vertebrate skeletons, the majority being, however, selected from among the mammals.

**Chemistry.** The course in Chemistry is the regular major course. During the first year it includes attendance on daily lectures and recitations on General Chemistry, and daily work in the laboratory. During the first half of the second year the student will attend lectures on Analytical Chemistry three times weekly, besides working in the laboratory; and during the remainder of this year will attend lectures four times weekly on the Chemistry of Carbon Compounds.

The instruction in the laboratory will be directed in such a way as seems best adapted to give the student a thorough knowledge of the pure science of chemistry and the methods peculiar to it. This kind of instruction is considered to be the best basis, whatever the object may be which the student has in view.

At first the student will make himself acquainted with the action of the various classes of substances upon each other, by actual observation at the laboratory desk; and his knowledge will be constantly tested by means of appropriate problems given him for solution. After completing this course, he will be enabled further to test his acquirements by taking up a course of qualitative and quantitative analysis. At intervals during the time he is engaged in this work he will be required to prepare chemical compounds in a pure state, so that his ideas concerning chemical action may become enlarged, and his knowledge of the special properties of the different classes of compounds more definite and detailed.

**Biology.** The course required is the regular major course. (except that, for prospective medical students, Mammalian Anatomy is recommended instead of general Comparative Anatomy in the second year; those who prefer may, however, take Comparative Anatomy instead.)

The course is designed to give the student, in the first place, a knowledge of the laws of life in general, whether exhibited in animals or plants; and secondly, a special knowledge of Mammalian Anatomy and Animal Physiology. Human of physiology is taught as a part of general physiological science, the student being left to acquire its clinical and hygienic applications as part of his medical studies proper; and, similarly, human anatomy is left for the medical school curriculum. It is believed that by approaching these sciences from a general scientific standpoint the student will be best prepared for the study of pathological structure and function; and that a great advantage will result from his being able to concentrate his attention on the professional applications of the biological sciences when he enters a medical school.

The order of biological study will be as follows:

1. General Biology.—Lectures, recitations, or examinations, three times weekly throughout one year, with daily laboratory instruction. This course is intended to bring prominently before the student the fundamental phenomena presented by living things, as gathered from the detailed study of a number of typical plants, and of a specimen from each of the main groups of the animal kingdom. The embryonic development of the chick is also studied in detail. In this course beginners are taught how to dissect and observe animal structures. On the other hand, microscopic observation is usually not included. The student who desires special knowledge of the structure of plant tissues or of animal organisms should pursue this work through the study of Comparative Anatomy instead.

2. Human and Comparative Osteology.—Seventy lectures and recitations. The human skeleton being that most accurately and minutely described, and also that from which the greater part of the nomenclature of comparative osteology is derived, the student commences with it, and then proceeds to the examination of a number of typical vertebrate skeletons, the majority being, however, selected from among the mammals.

The biological studies of the final year include:

3. Zoology and Comparative Anatomy.—In this course the student is taught the principles of classification adopted in the animal kingdom and the characters of the various recognized classes and orders. He also studies in great detail the anatomy of one of the mammals, working in the same manner as a medical student on the human subject in the dissecting room. He thus acquires skill in dissecting and a thorough practical knowledge of the structure and arrangement of ossuous, muscular, vascular, nervous, alimentary, &c., systems in the Mammalia, so that on subsequently entering the dissecting-room of a medical school his necessary work will be largely reduced in amount, and he will be to a great extent ready to turn his attention at once to the technical minutiae of Anthropotomy.

4. Animal Physiology and Histology.—Mainly with reference to the human body. Two lectures and an examination weekly throughout the academic year. The microscopic structure of the tissues and organs is studied in this course, except so much as may already have been completed in the General Biology course. Students are required to perform for themselves the simpler physiological experiments, while others, more difficult but important, are demonstrated to them. The physiological apparatus belonging to the University is unusually good and complete; and students who follow this course will acquire a knowledge of the method of using all the chief instruments employed in physiological research; and, so it is hoped, will be qualified to carry out afterwards scientific investigations on the physiological action of drugs, in experimental pathology, etc.

5. From time to time short advanced courses of lectures on special physiological topics are delivered.

**German and French.** A minor course is required from those who take up these subjects. In this, students receive such instruction as should enable them to read at sight ordinary French and German, to render English into French and German, and to understand French and German grammar.

**Drawing.** The amount of skill demanded is such as will enable the student to represent a bone, a dissection, or a microscopic preparation with accuracy.

**English.** The minor course in English includes the critical study of a play of Shakespeare, of the elements of Anglo-Saxon, and of selections from Chaucer. It aims at giving an insight into the history and genius of the language, and at increasing the student's facility and power in the use of it as an instrument of expression.

**Mathematics.** The minor course includes: (a) Conic Sections, and (b) Differential Calculus.

**Logic and Psychology.** A course of study in these subjects will be definitely announced hereafter.

II. COURSE FOR NON-MATRICULATED STUDENTS.

While the University authorities are desirous, and use their influence, to induce all prospective medical students to take the above complete college course, it is, nevertheless, found that many such students apply for admission without being able to pass the full matriculation examination, or to take up all the studies required for graduation. The Trustees, believing that many of these candidates would derive substantial benefit from the full courses of Scientific Instruction provided in the University, have arranged to admit to certain portions of the Course Antecedent to the Study of Medicine,
those undergraduates who can pass an entrance examination less strict than that for the regular University matriculation, but still such as to show that they have had a fairly good preliminary education. The subsequent studies extend throughout three years, and are primarily intended to ensure that the student has a good knowledge (based largely on practical laboratory study) of Physics, Chemistry and Biology. Such non-matriculated students are not recognized as candidates for the B. A. degree.

Entrance Examination.

The requirements for entrance to this course are as follows:

**English.** Candidates will be examined in the whole of Lounsbury's History of the English Language, and will be required to satisfy the examiner, by means of a written composition, of their ability to express themselves in correct and idiomatic English, properly spelled, punctuated, and divided into paragraphs.

**Elementary Mathematics.** Arithmetic; Algebra; three books of Euclid, or an equivalent amount of Geometry; Plane Trigonometry, and the use of Logarithms.

The examination in algebra will be confined to the following: definitions and explanations of algebraical signs and terms; addition, subtraction, multiplication and division of algebraical quantities; ratio, proportion and variation; simple equations involving not more than two unknown quantities.

**Latin.** Translation of passages from the first four books of Caesar, De Bello Gallico, and of the sixth book of the Aeneid; the elements of Latin Grammar, especially Accent.

Candidates who obtain permission at least a fortnight previously, will be permitted to offer themselves for examination in equivalent portions of other Latin classics than those prescribed above.

**Physical Geography.** Guyot's Physical Geography and Huxley's Physiography are recommended as text books.

**French and German.** In addition to the above subjects, candidates may offer themselves for examination in French and German; those who pass will be excused from attendance upon the instruction in those languages during the subsequent course of study.

The examination in French and German will test the candidate's knowledge of the elements of the Grammar of those languages, and his ability to translate at sight easy passages from prose authors.

**Drawing.** Some knowledge of Drawing is very desirable; students who are proficient in this subject may omit it from the subsequent course.

Summary of the Course.

**First Year's Studies.**
2. Chemistry. 5. Drawing.
3. German or French.

**Second Year's Studies.**
1. Chemistry. 3. Human and Comparative Osteology.
2. General Biology. 4. French or German.

**Third Year's Studies.**
1. Anatomy. 2. Physiology.
3. *Logic and Psychology, or English Language and Literature.

*For the subjects under 3, any other of the minor courses taken by candidates for the B. A. degree may be substituted, provided the instructors find the student fit to profit by them.

Explanation of the Course.

**Physics.** The course in Physics is the same as the minor course (see p. 118,) required to be taken up by candidates who present this subject as one of those in which they desire to graduate.

**Chemistry.** The course is the same as the major course for the B. A. degree (see p. 118,) except that somewhat less practice in quantitative analysis is demanded.

**Biology.** The amount of study required is the same as that for the major course (see p. 118).

**English Prose Style.** The course in English Prose Style will comprise an examination of the style of one or more characteristic English authors, together with exercises in paraphrasing and original composition. One hour a week will be spent in class-room work, and at least another hour will be required for preparation.

**Drawing.** Sufficient skill to enable the student to represent anatomical and histological specimens.

**Logic and Psychology, English.** The amount of study required is that represented by the regular collegiate minor courses in those subjects (see p. 118).

**Field Club Excursions.** All members of the University are eligible as members of the Baltimore Naturalists' Field Club. Non-matriculated students taking the course antecedent to medical studies are required during their two years of biological study to go on the excursions of the Club—and to each is especially allotted some one group of animals and plants, for collecting, preserving and arranging which he is, under guidance, responsible.

**Note.** Students who clear off at the entrance examination the French and German demanded, or who for any other reason have time to spare, may take up full major courses in Chemistry and Physics, or may enter any other of the University classes on proving their fitness to the satisfaction of the instructors.

III. SPECIAL STUDENTS.

Young men of collegiate age, who can satisfy a committee consisting of the President and two of the chief instructors that they are sufficiently advanced in character and attainments to be allowed the privilege, and that there is some good reason why they should not offer themselves for matriculation, may be admitted to certain classes; but this privilege is liable to be forfeited at any time, provided the committee is satisfied that there is sufficient reason for its withdrawal.

Students attending the medical schools at present established in the city may thus occasionally obtain permission to attend the courses in Physics, Chemistry, or Physiology, and have the advantage of instruction in the Laboratories of the University. Such students are not, however, entitled to be enrolled as members of the University.
Scientific Periodicals Published under the Auspices of the Johns Hopkins University.

I.

AMERICAN JOURNAL OF MATHEMATICS.

Professor J. J. Sylvester, F. R. S., D. C. L., Editor in Chief; W. E. Story, Ph. D., Associate Editor in charge. Quarto. Quarterly. Subscription $5.00 per year.

Vol. i. 1878. 388 pp. 4*. 4 plates.
Vol. ii. 1879. 404 pp. 4*. 3 plates.
Vol. iii. 1880. In progress. Three numbers printed.

II.

AMERICAN CHEMICAL JOURNAL.

Professor I. Remsen, M. D., Ph. D., Editor. Octavo. Bi-monthly. Subscription $3.00 per year.

Vol. i. 1879. 460 pp. 8*.
Vol. ii. 1880. 456 pp. 8*.
Vol. iii. 1881. In progress.

III.

THE AMERICAN JOURNAL OF PHILOLOGY.

Professor B. L. Gildersleeve, Ph. D., LL. D., Editor. Octavo. Quarterly. Subscription $3.00 per year.

Vol. i. 1880. 520 pp. 8*.
Vol. ii. 1881. In progress.

IV.

STUDIES FROM THE BIOLOGICAL LABORATORY.

Professor H. N. Martin, Dr. Sc., Editor, and W. K. Brooks, Ph. D., Associate Editor. Octavo. Price $5.00 per volume.


This includes contributions from the University to various Biological journals, and also the papers independently printed as the "Results of the Chesapeake Zoological Laboratory."

As a considerable proportion of the contents of the Studies consists of reprints from the Journal of Physiology, subscribers to the latter may obtain the "Studies from the Biological Laboratory" for $3.50 per volume.

V.

THE JOURNAL OF PHYSIOLOGY.

Michael Foster, M. D., F. R. S., Cambridge, England, Editor in Chief. Octavo. Six parts will form a volume of about 500 pp. Subscription $5.00 per volume.

Vol. i. 1878–79. 626 pp. 8*. 17 plates.
Vol. iii. 1880–81. In progress.

This Journal will in future be published in America with the aid of the Johns Hopkins University, and will be issued from the University to subscribers.

The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom copies may be obtained. They may also be procured, as soon as published, from Messrs. CUSHINGS & BAILEY, No. 202 West Baltimore Street, Baltimore. Price 5 cents each.