

rhetoric. The department of elocution and oratory was attached to the latter chair.

After the resignation of Professor Shackford in 1886, the duties of both departments again devolved upon Professor Corson, until the election of Dr. James Morgan Hart as professor of rhetoric and English philology in 1890. Professor James Morgan Hart was the son of Dr. John S. Hart, the well-known educator, formerly a professor in Princeton College. Professor Hart graduated at Princeton and afterward received his degree of Doctor of Laws at the University of Göttingen. During his first residence abroad, between 1860-65, he resided in Geneva, Göttingen and Berlin. Upon his return to this country he entered upon the practice of law, but was soon called to Cornell University as assistant professor of French and German. He remained here until 1873. From 1874-8, he was engaged in literary work in New York and in editing a series of German classics. During this time he published his very interesting work upon German universities. After residing for a second time abroad in which he devoted himself especially to the study of English philology, he was called to the University of Cincinnati where he filled the chair of English and German from 1876-90, from which he was summoned again to Cornell University, with which he had been associated in the early years of its history. Since the creation of a special chair for English philology, the work has been systematically arranged and received a large development and growth. Professor Hart has set himself vigorously to elevate the instruction in rhetoric and especially in elementary English, in which he found the prevailing instruction in the secondary schools of the State very deficient. His services in this direction, both within the university and in the public schools, have effected a revolution in the character of the instruction in this study.

The instruction of the first year in English is practical rather than literary. It consists chiefly of reading and interpreting good nineteenth century prose, De Quincy, Macaulay and Carlyle, and writing copiously upon the subjects embodied in or directly connected with the readings. The aim of the instruction is to widen the student's range of ideas and to enlarge his vocabulary and to quicken and guide his powers of expression. The work of the second year is more literary. The readings are in Johnson, Goldsmith, Gibbon and Burke, all writers of the eighteenth century. The essays are longer than in the previous year, and stress is laid upon the outline and general treatment of them; also

upon collateral reading. In the advanced elective work, the aim of the junior and senior years is to train teachers of English and persons of evident literary aptitude. Only such persons are admitted to the junior class as have received distinction in the lower classes. The readings in the senior year may be assigned to Bacon, Milton, Dryden and Swift, and the essays become more elaborate and represent studies in the lives, writings and opinions of the authors read. Attention is also paid to the historical treatment of certain features in the formation of prose style and in the special study of the Elizabethan English. Senior rhetoric is professedly a seminary for the training of teachers of English. The instruction is adapted throughout to the needs of teachers. The general theory of composition is reviewed. The books prescribed for entrance examinations in English by the New England Association of Colleges are studied. Select passages are examined which illustrate the principles of invention and style, and model subjects are drawn up for the practical use of high-school classes. The study of English philology is entirely elective. There is one popular course, all the others are professional. The former course is open to all members of the university and is not designed for persons wishing to make a special study of philology. The work consists of lectures upon the development of the language down to the present day, illustrated by the reading of very brief specimens from the successive periods. For the systematic study of English philology a knowledge of the classics is also required and apt acquaintance with modern German. One term is devoted to the study of Gothic, and two terms to reading a very moderate amount of Anglo-Saxon prose and verse and to mastering the grammar; a good deal of comparative Indo-European grammar is introduced. The advanced course consists in reading long texts both prose and verse and in reviewing the more difficult points of grammar and in noting dialectic peculiarities. A course in Middle English, the general modification of the language from the Norman conquest to Chaucer, is arranged, in which especial attention is paid to the Midland dialect. Courses also in English phonetics, in Old Saxon, in Icelandic and in general Germanic philology are given, but not in every year. The students making special study of English philology for the doctor's degree also pursue courses in Sanskrit or in Indo-European philology under Professor Wheeler.

THE ROMANCE AND GERMANIC LANGUAGES.

The first professor of languages in this department chosen was one of the two professors first elected in the university. William C. Russel was elected at the fifth meeting of the Board of Trustees held in Albany, February 13, 1867. He was elected to the chair of modern languages and adjunct-professor of history. It is not clear whether it was the original purpose to combine the two chairs originally proposed, viz., that of the South European languages and of the North European languages, which were provided for in the plan of organization in one chair by this designation or not. Professor William C. Russel was a nephew of the famous William Channing whose name he bore. He was a graduate of Columbia College in the class of 1832. After graduation he was admitted to the bar and engaged in the practice of his profession in New York until 1863. At that time there came a sudden and painful interruption in the practice of his profession, occasioned by the death of a beloved son, who had entered the army as an officer in Col. Shaw's regiment of colored troops and had been killed in battle. In order to recover his body, he went south. Later his philanthropic spirit led him to take service in the Freedman's Bureau, and, for a brief period, he gave instruction in the department of metaphysical, moral and political science in Antioch College. After his election to the chair of modern languages in Cornell University he went abroad to familiarize himself with the present state of modern literature in the department to which he had been elected.

The first assistant professor in the department was James Morgan Hart, who was transferred in 1870 to the department of German. Then followed W. M. Howland, retired in 1870; F. L. O. Roehrig, retired in 1884; Alfred Stebbins, retired in 1882, and T. F. Crane, assistant from 1870 to 1873, when he was appointed professor of Spanish and Italian, while retaining his duties as assistant professor of French. In 1881, upon the retirement of Professor Russel, Professor Crane was placed at the head of the department, the title of which was, in 1882, changed to that of Romance Languages and Literature.

Instructors have, since the retirement of Professors Stebbins and Roehrig, taken the place of the earlier assistant professors. Italian and Spanish were not taught regularly until the return from Europe of Professor Crane in the fall of 1870. Since that time classes in French, Spanish and Italian have been taught regularly, and in addition to

these the earlier dialects of French, including old Provençal and Italian, have been taught to advanced students from time to time. Besides the usual courses in the language and literature of France, Spain and Italy, the philology of the Romance languages in general, and of the several languages in particular, have been taught in the Romance Seminary.

The general library is well supplied with works on the languages and literature of the Romance people, and the Seminary Room contains the most important philological journals and special treatises needed for the most advanced study in this department, as well as palæographical material for the study of early texts, etc.

As at present organized the department consists of a full professor and four instructors, among whom the following work is divided: Nine sections of freshmen French; six sections of sophomore French; six sections of advanced French; two sections each of Spanish and Italian, and two seminaries, one dealing with philology, the other with advanced literary history.

Much attention is paid to the study of modern French, and instruction in conversation and reading, under the charge of a native Frenchman, is constantly offered.

About 450 students are usually pursuing studies in this department. Although no fellowships have been attached to the department, a number, usually in connection with the German department, have received special training in the department, of these Mr. C. R. Wilson is now professor of modern languages at Iowa State University, and Mr. Schmidt-Wartenberg is an associate professor of German in the University of Chicago. Two other fellows, Mr. Ruyter (died in 1890) and Mr. Lapham have filled the position of instructor.

In February, 1868. Mr. Willard Fiske was elected professor of the North European Languages, and we may assume that by this action the chair of modern languages was definitely divided as originally contemplated. Professor Fiske was born in Ellisburg, N. Y., and removed in early boyhood to Syracuse, where he formed a life-long friendship with Andrew D. White, later president of the university. Professor Fiske spent a short time in Hamilton College. Here he conceived a passion for the study of Icelandic, and, though a mere undergraduate, visited Vermont in order to see George P. Marsh, the famous scholar and later diplomatist. Filled with a boyish enthusiasm, young Fiske undertook a journey to the north of Europe, and next appears as a student in

the University of Upsala in Sweden. Here he spent two years participating thoroughly in that Norse life which had such a fascination for him, interest in which he has retained until the present day. He visited Germany on his return to America, and soon after received an appointment as assistant-librarian in the Astor Library. Here he remained for several years, but failing of promotion as he anticipated, he resigned and accepted the appointment of secretary of the American Geographical Society. Later he became a journalist, and was for a time one of the editors of the Syracuse Journal in his native city. A man of great enthusiasm, a charming conversationalist, with the power of winning and retaining friends, he has had at different times various enthusiasms. He collected the largest chess library in America, and organized the first chess congress at which Paul Morphy, the greatest name in modern chess, won such distinction. He also established the Chess Monthly. His experience as a librarian and his familiarity with the languages of Northern Europe suggested him as a suitable man for librarian of the university and as professor of the Norse Languages, but he assumed for a time the professorship of German as well. He entered upon his duties in January, 1869. At the opening of the university he was traveling in Europe and acting as correspondent of one or more newspapers.

The work in German was organized at the opening of the university by Mr. T. Frederick Crane, at that time a young lawyer in Ithaca, who was engaged temporarily, in the absence of Professor Fiske, during the fall term. Mr. Crane on returning from Europe where he had prosecuted studies in the Romance languages in Berlin, Florence, Madrid and Paris, was elected assistant professor of Modern Languages on June 30, 1870. On September 10, of the same year, Waterman T. Hewett was elected first assistant-professor of North European Languages, and Bela P. McKoon second assistant-professor of North European Languages, and Alfred Stebbins assistant-professor of the South European Languages. Both departments were then fully constituted with one full professor and three assistant-professors, Professor Crane appearing as assistant-professor of Spanish and Italian. In 1873 (upon the resignation of James Morgan Hart), Hjalmar H. Boyeson was appointed assistant-professor of the North European Languages, and three years later professor of German Literature. The department was thus constituted until the year 1877, when, during the absence of Assistant-Professor Hewett in Europe, Assistant-Professor

Horatio White of the classical department took much of his work and on January 25, 1879, owing to the continued ill health of Professor Fiske, he was elected assistant-professor of German for one year. During the first decade in the history of the university, the field of instruction in modern languages was somewhat enlarged. Professor Boyeson delivered a course of lectures upon the history of German literature which had not been previously given, and Professor Crane offered new courses of instruction in Spanish and Italian. After this period, the field of instruction both in German literature and the related languages was enlarged. Instruction was given by Professor Hewett in Dutch and later in Gothic, Old German and Middle High German. Additional electives were offered by Professor White in the modern literature. Upon the resignation by Professor Fiske of the chair of North European Languages in 1883, two professorships of German were established to which Assistant-Professors Hewett and White were promoted. The department has collected a valuable material to illustrate the study of German literature, in lantern slides containing views of old German life and art, manuscripts, pictures of authors, texts and of characters and scenes in literature and history.

XII.

THE DEPARTMENT OF PHILOSOPHY.

THE earliest instruction in Philosophy devolved upon Dr. William D. Wilson, who had held a similar professorship in Hobart College from 1850 to 1868, the date of his election to a chair in this university. Dr. Wilson's instruction embraced courses in Mental Science, Logic, the History of Philosophy, the Philosophy of History, and at times in Political Economy. All students will recall the venerable professor whose appearance of age belied his genuine physical vigor. As registrar of the university he came in contact with all students for at least seventeen years. Dr. Wilson seemed to possess an untiring capacity for the laborious clerical work associated with the registrar's office. The numerous details, the multitudinous reports from various departments, it devolved upon the doctor to receive and enter. If, occasionally, a student incautiously stepped into his presence with his hat on, a re-

minder from the punctilious registrar did not lessen the genuine esteem with which he was regarded. As a scholar, Doctor Wilson was an indefatigable reader upon all questions of philosophy, theology, ecclesiastical history, science and political economy. Several works which he published exhibited the acuteness of his mind, as well as a fresh and vigorous grasp of the new points presented for solution. Doctor Wilson's long educational experience, and his interest in the general educational policy of the State, as well as his attendance at the meeting of the University Convocation during many years, made him an influential and esteemed character in the university life of our State. His theological interests caused him to be chosen for many years to the national triennial conventions of the church with which he was connected, where he filled important positions upon some of the most important committees. The class of — caused his portrait to be painted, and presented it as its memorial upon graduation to the university. Since his resignation here, Doctor Wilson has been active in theological instruction and advice in connection with the Divinity School of Syracuse, and in lectures before educational institutions in the State.

At the meeting of the Board of Trustees held November 20, 1885, a proposition was presented from the Hon. Henry W. Sage to endow a professorship of Ethics and Philosophy in memory of his wife, which should bear her name. In nominating as he did, on January 6, 1886, Dr. J. G. Schurman as the first incumbent of this chair, he states: "Before closing this report, I desire to put upon record for permanent remembrance this statement: that my chief object in founding this professorship is to secure to Cornell University for all coming time the services of a teacher who shall instruct students in mental philosophy and ethics from a definitely Christian standpoint, and while the title which I gave in my former communication comprehends in a general way just what I mean, I think it best to ask that the following more exact wording of it be the one adopted for actual use, viz., Susan E. Linn Sage Professorship of Christian Ethics and Mental Philosophy." He added: "I was happy to find not only through the correspondence held with Doctor Schurman, but also through the personal interview above referred to, that his habits of teaching and thinking are quite in harmony with the desires I entertain in founding the chair. While Doctor Schurman attaches no importance to denominational distinctions, there is abundant evidence that all his teaching is from a distinctively Christian point of view."

The young professor to whom this important department was entrusted was, as his name shows, the descendant of a Dutch family which came to New York and settled near New Rochelle more than two hundred years ago. The family, not sympathizing with the popular cause, removed to Prince Edward's Island, where Jacob Gould Schurman was born in May, 1854. He studied at the Prince of Wales College, Georgetown, in 1870, where he won a government scholarship, which enabled him to pursue his education for two years more. During the years 1873-4, he was a student at Arcadia College, where he also won first class honors in English and in classics. In 1875 he gained the Gilchrist scholarship for the Dominion of Canada, which enabled him to continue his studies in the University of London, where he received the degree of Bachelor of Arts after two years' residence, and obtained a scholarship in philosophy, tenable for three years, and also the Hume scholarship in political economy at University College, London, tenable for three years. In 1878 he received the degree of Master of Arts, mainly by studies in logic and psychology. Later, he received the degree of Doctor of Science at the University of Edinburgh, and obtained the Hibbert traveling scholarship for Great Britain and Ireland, which enabled him to study in Germany and Italy for two years, from 1878-80. During this period he spent one year under the instruction of Professor Kuno Fischer at the University of Heidelberg. He also spent a semester at the University of Berlin, and also at the University of Göttingen. He had thus passed through an admirable preliminary training under the most advanced teachers, a course in English, Scotch and German philosophy. Upon his return to Nova Scotia, in 1880, he was appointed professor of English Literature in Acadia College. In 1882 he accepted the chair of Metaphysics and English Literature in Dalhousie College.

At the meeting of the Board of Trustees held October 22, 1890, Mr. Sage announced his intention of adding to the endowment of the professorship which he had established in 1886 in memory of his wife, by a further gift of two hundred thousand dollars to the Department of Philosophy. His object was to provide permanently at Cornell University philosophical instruction and investigation of the most varied kind and of the highest order. To this end he stipulated that the trustees should for all time supplement the proceeds of his endowments with generous annual appropriations from the general funds of the University. The trustees accepted the gift with the condition at-

tached and to commemorate the munificence of Mr. Sage, and his profound interest in the subject of philosophy at Cornell University, they gave the name of the Susan Linn Sage School of Philosophy to the department thus enlarged.

Mr. Sage announced his purpose to extend the Department of Philosophy into a complete school for the study of ethics and philosophy. His main purpose may be inferred from the words which he used in closing his letter announcing this gift to the university:

“ Heretofore Cornell has done little at her own proper cost to uplift the moral and religious element in her students. True, we have had this department of ethics several years; and we have had the chapel and its preachingship eighteen years, but these have been carried on with very little expenditure from the funds of the university. We have done much, very much, for the foundations in science, in technical work, in agriculture, the classics, and modern languages, in history and economic studies, in ornamentation of our campus, and noble buildings for all purposes; but for the top work of man’s structure and development, the crown of his character and achievement, through his moral and religious nature—little, very little! Our function here is to educate man, and through education to provide foundation of character, based on moral principle, which shall underlie the whole man, and give impulse, tone and color to all the work of his life. We can not do that without facilities for cultivating and developing every side of his nature. Increase of knowledge addressed solely to the intellect does not produce full-rounded men; quite too often it makes stronger and more dangerous animals, living moral quality dormant, and the whole power of cultivated intellect the servant of man’s selfish, animal nature. No education can be complete which does not carry forward, with the acquisition of knowledge for his intellectual side and physical wants, a broad and thorough cultivation of his moral and religious side, developing Christian virtues, veneration, benevolence, conscience, a sense of duty to God and man, purity and right living in the largest sense. In short, wise and broad education should and will ally man’s intellect to his moral and religious, more completely than to his animal nature, and from that alliance results all the real dignity there is in mankind, making moral and intellectual qualities regnant, all others subject! I am so fully impressed with the vital importance of this subject, and the purpose of the proposed gift, that as trustee of Cornell university (with greater love for its policies and functions than I can

express), I think you can afford to accept this gift with its attendant liabilities, and that you cannot afford to decline it. It is my free and voluntary offering for a purpose, the highest, the noblest and the best ever promoted by this noble university."

His purpose to found a chair of Christian ethics and philosophy had been cherished by him for several years before its realization was possible. Later he desired to enlarge the department which he had thus founded, and he requested Professor Schurman to go to Europe for the purpose of carefully investigating the best methods of teaching ethics and philosophy and to formulate from them and from his own experience and judgment a plan of organization for a broad school embracing these subjects. Professor Schurman accepted with pleasure this opportunity to enlarge the field of instruction in America in his favorite department of study, and upon his return submitted a plan of organization which would satisfy the demands of modern science and scholarship and place the department abreast of philosophical schools in Europe. He proposed a chair of psychology to be filled by a professor versed in physiology and anatomy, especially of the brain and nervous system and skilled in the methods of experimental research in mental phenomena, the design being to establish here such investigations as are conducted in the great psychological laboratories of Paris and Leipsic; secondly, a more liberal provision for those branches which constitute philosophy in the older sense of that term, viz., logic, metaphysics and ethics—the field of theoretical philosophy. A third line of development should account for the religions of mankind by the study of comparative religion. Professorships for the study of comparative religion exist in Holland, France and Scottish universities. To this chair it was proposed to assign the department of Christian ethics. Attention was called to the fact that every science in America had its organ save philosophy. It was proposed to found a philosophical periodical to stimulate and to some extent shape and control the philosophical activity of the continent. It was proposed to establish six scholarships and three fellowships in philosophy and ethics, to be open to graduate students only, and also to found a psychological laboratory. The chair of pedagogy, which is simply psychology applied to teaching, which had already existed in the university for four years, was transferred to the School of Philosophy, as it is in other universities. To carry out this noble purpose Mr. Sage offered to give \$200,000 upon condition that whatever additional support was

necessary for the development of the department, should be added from the general fund of the university. Dr. J. G. Schurman was appointed dean and professor of the new Susan Linn Sage School of Philosophy. The Reverend Charles Mellen Tyler, a graduate of Yale university and a resident clergyman in Ithaca, was elected to the professorship of the history and philosophy of religion and of Christian ethics, and provision was made for the appointment of assistant professors of ancient and modern philosophy and a professorship of psychology. Three fellowships of four hundred dollars each were established and six scholarships of two hundred dollars each. Dr. Schurman established a philosophical seminary similar to those employed in the German universities and also gave, during the spring term, a course of public weekly lectures open to all members of the university, on the elements of ethical theory and the history of ethical ideals and institutions among mankind. In addition to the regular courses of instruction a series of public lectures were announced for the fall term, among which were included the inaugural address of Reverend Professor Tyler; a lecture by Professor Schurman on the Mental Development of Cardinal Newman; a lecture by Mr. Caldwell on the Latest German Pessimism; by Dr. Willcox on Marriage and Divorce in the United States, and by other members of the school. The first announcement of the school presents a required course of study in physiology, psychology and logic, and advanced courses in psychology, with experimental illustrations of mental phenomena susceptible of experimental treatment, sensations considered in their physical, physiological and psychological aspects, etc.; the history of Greek philosophy, including Alexandrian and Roman; the history of modern philosophy; contemporary philosophy in Europe; the history of religions; ethics; two courses, elementary and advanced, on the science and art of teaching; the writings and philosophy of Plato and Aristotle; Spinoza's Ethics; Leibnitz's philosophical works; Hume's treatise on Human Nature; metaphysics and epistemology; Kant's Critique of Power and Reason; the philosophy of religion; advanced ethics; practical ethics; the history of education.

Four seminaries were organized in connection with the school, viz., psychological, metaphysical, ethical and pedagogical. And a general philosophical symposium was announced to be held weekly to be devoted to the literature of contemporary philosophy as presented in the periodicals of English and foreign languages with reports and abstracts of the important articles, and discussions of new books. Upon the

resignation of Professor Angell, Edward B. Titchener of the University of Oxford was appointed his successor. Advanced subjects of instruction have been introduced and the department has received constant development.

PEDAGOGY.

In President White's final report presented to the trustees on June 17, 1885, the question of establishing a department of instruction for teachers was presented, and it was proposed that a lecturer on methods of instruction be appointed in order that graduates of this university who proposed to pursue the profession of teaching should be equipped by the study of the history of education and of the theories of the greatest educators as well as by the study of philosophical methods of instruction. It was thought in this way that students who had received a university training would likewise have it in their power to obtain the special specific training which was afforded in normal colleges. Teaching above all else must be taught by example, and thorough scientific training is the best preparation to qualify for imparting instruction.

President Adams in his inaugural elaborated the suggestion which his predecessor had made and urged the appointment of a professor of the science and art of teaching, as a means of making more intimate the relations between the university and the school system of the State. On December 18, 1885, a professorship of the science and art of teaching was established and Dr. Samuel Gardiner Williams was transferred from the department of geology to the department of pedagogy. Professor Williams had had a long and successful experience as an educator, and was familiar not only with current questions of education and school economy, but had occupied an influential position among the teachers of the State. The honored position which he held among the representatives of colleges and schools in the convocation qualified him to inaugurate the new department.

The formal instruction in pedagogy began with the opening of the university year of 1886-7. During the first two terms courses of instruction in the institutes and in the history of education were given. The third term was devoted to a conference for the discussion of educational subjects. It was soon found that the history of education needed a full year for its treatment. The course of instruction in

school supervision has been added, also a seminary for the examination of the great works of educational reformers. The aim of the department has been from the first to prepare graduates for successful work in the secondary schools. In this respect it has accomplished excellent results. With the organization of the School of Philosophy, the Department of Pedagogy was incorporated with it.

XIII.

THE DEPARTMENT OF HISTORY AND POLITICAL SCIENCE.

President White in his inaugural address had said that there were two permeating or crowning ideas which must enter into the work of the university in all its parts, "first, the need of labor and sacrifice in developing the individual man in all his nature and in all his powers, as a being intellectual, moral and religious. The second of these permeating ideas is that of bringing the powers of the man thus developed to bear upon society. In a republic like this, the way in which this is most generally done is by speech. A second mode of bringing thought to bear upon society is by the press. Its power is well-known, but its legitimate power among us might be made greater and its illegitimate power less. I think that more and more the university should have the wants of the 'fourth estate' in view. We should, to meet its wants, provide ample instruction in history, in political science, in social science and in the modern literatures." He had proposed to make much of scientific study. After speaking of the value of scientific study he said: "We believe that it will make the students strong for study in language and literature; but while we would give precision and strength to the mind in these ways, we would give ample opportunity for those classes of study which give breadth to the mind, and which directly fit the students for dealing with state problems and world problems. In this view historical studies and studies in social and political science will hold an honored place, but these studies will not be pursued in the interest of any party. On points where honesty and earnest men differ, I trust we may have courses of lectures presenting both sides. I would have both the great schools in political economy represented here by

their ablest lecturers." The crowning ideas here indicated were worthy of the man and the occasion. They were fitted to express the double aim of a great national university, and they will remain as a noble tribute to him who uttered them. Similar views were contained in the plan of organization two years before. He emphasized the importance of a department of jurisprudence, political and social science and history, and said: "We believe that the State and Nation are constantly injured by their chosen servants, who lack the simplest rudiments of knowledge, which such a department could supply. No one can stand in any legislative position and not be struck with the frequent want in men otherwise strong and keen of the simplest knowledge of principles essential to public welfare. Of technical knowledge of law and of practical acquaintance with business, the supply is always plentiful; but it is very common that in deciding great public questions, exploded errors in political and social science are revamped, fundamental principles of law disregarded and the plainest teachings of history ignored. In any republic, and especially in this, the most frequent ambition among young men will be to rise to positions in the public service, and the committee think it well at least to attempt to provide a department in view of these wants . . . The main stock in political economy and history of most of our educated public men is what they learned before they studied their professions. Many an absurdity, uncorrected at college, has been wrought in the constitutions the statutes of our great Commonwealth; and when we consider that constitution-making for new states and old is to be the great work in this country, of this and succeeding generations, surely we do well to attempt more thorough instruction of those on whom the work is likely to fall." The young president in these words exalted his own favorite studies, but they illustrate besides his personal interests in all political and social questions which concern the state and society—an interest so profound that it has led him, in the studies of his later years, to devote more attention to questions of sociology than to the earlier historical subjects, to which he was devoted.

HISTORY.

In the organization of the Department of History, President White was made professor of history, and William Channing Russel, associate professor of history. Professor Goldwin Smith, who had purposed to come to the United States to study its political institutions, with the

intention of residing in some university town, had been won for this university by President White, during his trip to Europe in the summer of 1868. Professor Wilson lectured on the philosophy of history, the history of philosophy and also upon political economy, in addition to his distinctive field of philosophy.

Professor Smith's name appeared in the first general announcement as non-resident professor of history. In the first catalogue he appears as professor of English and constitutional history. In the second catalogue, which was issued in the same year (1868-9), he appears as non-resident professor of English history. Professor Smith brought to the university not only the ripest scholarship, but an unusual sympathy with the aims of a new institution. He was willing to see it tested by the demands of this country and shaped by national needs. In a letter expressing his desire to be present at the opening, he said: "You say, you wish I could be with you, so I do, because the occasion will be one of the deepest interest; but you would not persuade me to give you any advice. I know too well the difference between the old and the new world; at least the only advice I should give you would be, without ignoring the educational experience of Europe, to act quite independently of it, and to remain uninfluenced either in the way of imitation or antagonism by our educational institutions or ideas. The question of academic education on this side of the water is mixed up with historical accidents and with political struggles, to which on your side there are happily no counterparts. . . . What I would say is, adapt your practical education, which must be the basis of the whole, to the practical needs of American life, and for the general culture, take those subjects which are most important and interesting to the citizen and the man. Whatever part may be assigned to my subject in the course of general culture, I will do what I can to meet the wishes of the authorities of the university without exaggerating the value of the subject or unduly extending its sphere." Professor Smith's contribution to the study of history in this university possessed a value which cannot be overestimated. During the first years of the history of the university he lectured usually twice a week for two terms in a year. He delivered lectures upon the general and constitutional history of England. It is perhaps not too much to say that, at that time, no such lectures upon history had ever been delivered in this country. Professor Smith is a brilliant word painter, with unsurpassed power of grouping the essential facts relating to a given period or character, so as to leave a clear and

vivid impression upon the mind. A character was mirrored in a sentence; the entire philosophy of a period was compressed into one terse picturesque statement. Associated with all, was a lofty moral judgment presiding over the acts of nations and of individuals, meting out with rigorous truthfulness, a nation's falsity to its ideals, or the fatal weakness of some great character. This inflexible moral standard pervaded his judgments, as it has pervaded his attitude toward every living question which has affected this nation since his residence among us. Professor Smith was in sympathy with American institutions. He regarded this republican government as the noblest and grandest achievement of the human race, and its struggle for freedom and liberty as the noblest struggle, demanding sympathy, admiration and recognition. When we consider that Professor Smith was an Englishman, who had only once before visited America, we must regard his thorough identification with the university, and with all its interests, as one of the most valuable gifts in its history. Soon after his arrival, finding how imperfect was the equipment for literary and historical study, he sent to England for his own private library, consisting of 3,400 volumes, the choice and valued books of his university life and of silent study, and presented them to the university. In the following year he gave \$2,500 additional for the purchase of works in history. Thus he signaled his devotion to a new university in a land distant from his own.

Professor Dwight of the Columbia Law School delivered yearly for four years a course of lectures on constitutional law. It is said that the term "College of History and Political Science" appeared first in this country in the second catalogue issued by the university, for 1868-9. Professor Dwight whose work as a jurist and lecturer ranks high in American legal education, delivered a systematic course of lectures, didactic and expository in character, as befitted the subject, which made them distinguished for their practical value among the early lectures of non-resident professors. The historical and political sciences were taught chiefly through lectures, but in early medieval history there were regular class exercises, the text book being "Gibbon's Decline and Fall of the Roman Empire." The lectures upon history were so arranged as to form a chronological sequence, ancient history being followed by the early medieval period, that by medieval and later modern history, and that again by the history of England and the constitutional history of the United States. The historical work as announced consisted of:

1. A course of lectures on ancient and early modern history by Professor

Russel; 2. Modern history in general, and the philosophy of modern history by President White; 3. The general and constitutional history of England by Professor Goldwin Smith; 4. General history and the philosophy of history by Professor Wilson; 5. American constitutional history by Professor Dwight; 6. Political economy by Professor Wilson. It was announced that the lectures of the resident professors extended through each trimester, while those of Professor Dwight, which were twelve in number, were given in the spring term.

In those early days there was a fair collection of mural charts, photographic views, portraits, casts and diagrams, including historical wall maps, and maps in physical geography. President White had issued for the use of his classes in Michigan University, outlines of a course of lectures in history, and, also, analyses of lectures on the greater states of continental Europe. In choice of subjects, President White preferred to discuss periods and individual men as representative of movements, rather than the orderly sequence of political events. His lectures were devoted, save, perhaps, in the periods of the history of the Reformation and the history of the French Revolution, primarily to the history of culture. He had prepared elaborate studies of the lives of great artists, and he dwelt with especial fondness and interest upon the history of art as an expression of the intellectual life. He reviewed naturally the history of the church during the period of the middle ages, and in its later influence upon the political life of Europe. He studied the influence of the founders of the great religious orders, but devoted especial attention at that time, and later, to what may be called studies in abnormal opinions. He thus prepared an elaborate course of lectures upon the history of torture and witchcraft. His later writings have embodied much that is curious and abnormal in the history of individual opinion, and especially isolated views of theologians—almost the sole scholars of the time—who did not possess a knowledge of the discoveries of modern science, but who opposed numerous theories of the physical universe, from quaint and fanciful reasons, often derived from theological speculation. Physical science did not at that time exist. There were chaotic visions of some of the results of modern science, not rising to the dignity of consistency, nor established by induction, but which, being unsupported, were often as much the product of the fancy as the opinions to which they were opposed. They could not challenge universal faith, for they had no foundation, save in the dim, pathetic, and often beautiful dream of

some solitary scholar. To withhold acceptance from unestablished truth, where faith may be opposed to unconfirmed science, is as much a duty as the challenge which conservative science gives to unsubstantiated scientific theory.

Few lecturers in the university were so interesting as President White. While positive and aggressive in opinion, and pungent in statement, he always awakened the interest of those who heard him, and inspired them to an interest in the study of history. They began to read, and never lost their enthusiasm for the subject. Mr. White always illustrated the bearing of history upon the solution of questions of modern politics and social science. "We find a bold and vivid treatment of such subjects as the fall of the Roman Empire; the feudal system; the crusades; the rise of cities; Mohammedanism; chivalry; monachism; the development of Papal power; the development of commerce; Christian clearing up of Europe; the rise of institutions of learning; growth of literature, science and law; the laboring classes in the middle ages; cathedral builders and medieval sculptors; the revival of learning; revival of art; Erasmus; Luther and the reformation in Germany; Luther's character, writings and influence; Ulrich von Hutten; Charles the Fifth; Charles the First; the reformation in the Romanic countries; the Thirty Years' War. Mr. White's special courses embraced "The State Life of Modern Europe. He prepared thirty-seven special lectures upon France, six upon Italy, three upon Spain, four upon Austria, six upon the Netherlands, five upon Prussia, five upon Russia, two upon Poland, and three upon the Turkish power. In this great field of modern historical politics, France was evidently his first choice, and in this special field the French revolution was clearly the supreme attraction." When we review these striking and suggestive lectures by President White upon French history, we can only regret that these lectures, carefully elaborated, might not have been published, and that this field, which was so attractive to him, might not have retained his permanent attention, the value of which, in the study of modern history and in the instructive lessons which it presents, far surpasses in importance Mr. White's later specialized field, in which his time has been spent in collecting a vast museum of isolated opinions from unenlightened ages, when no science existed, and contrasting them with the views of modern science. Professor William Channing Russel's work was confined at first to medieval and modern history. While closely uniting the study of text books with

lectures, he also embodied one feature of the modern seminary plan by occasionally requiring essays upon certain subjects studied. These essays did not have the character of original investigations, but rather a systematic presentation by the student of the main facts bearing upon a given question. Later, Professor Russel assumed systematic instruction in American history, which was continued as long as he remained connected with the university. In 1878, a two years' course in history and political science went into operation, which continued for three years. It included most of the instruction in history which was given in the university, and involved few requirements for admission save the ordinary examinations and four books of Cæsar. In 1881 this course was extended to four years. Students who had completed the first two years of study in arts, literature, or philosophy, might be admitted to full standing as juniors in the course in History and Political Science, on passing a satisfactory examination in the history required in the first two years of this course. The first two years in this enlarged course were devoted to the languages, and to elementary mathematics and history.

Upon the resignation of Professor Russel in 1881, Professor Moses Coit Tyler, of the University of Michigan, was elected to the vacant chair of history in Cornell University. After accepting the position, he was permitted, at his own request, to devote himself to instruction in the field of American history exclusively. As early as the year 1868, President White had suggested the establishment of a chair of American history as one of the necessities in the future education of this country, and in his report to the trustees of the university for 1871-2, he had said: "As regards history, it is not known that any institution in the country has so extended a course, but there is a needed addition here, and I hope at an early date to see the history of our country fairly and fully treated. It is a curious fact and one not very creditable to our nation that at present if any person wishes to hear a full and thorough course of lectures on the history of this country, he must go to Paris or Berlin for it. That the subject can be made interesting is shown by the crowds who flocked to the lecture rooms of Neumann, the German, or Laboulaye, the Frenchman. That it is important needs no proof. We ought soon to have a series of lectures, with judicial fairness going over the great periods of our history, doing justice to all parties and being unduly enthralled by none. My plan would be to take four or five thoughtful men and assign to each a period, say to

the first, the colonial period; to the second, the period of the Revolution; to the third, the period from the Revolution to the war of 1812; to the fourth, the period extending from the war of 1812 to the beginning of our Civil war. I believe that such a course well prepared would be a powerful instrumentality in sending out from this institution a great body of men above the level of mere partisanship and beyond reach of corruption." On September 22, 1871, George Washington Greene was appointed non-resident professor of American history for one term. Professor Greene had resided for many years abroad. In his first trip to Europe he had met by accident at an inn in southern France Mr. Henry W. Longfellow, and the friendship then formed grew with the succeeding years of their lives. Mr. Greene had made an exhaustive study of the period of American history at the close of the last century, for the preparation of an elaborate life of his grandfather, General Nathaniel Greene, one of the bravest soldiers of the Revolutionary war. Mr. Greene was a man of gentle spirit and delightful personality, full of reminiscences of his varied experiences, and of the famous men with whom he had been associated abroad, but of delicate health. His lectures were read quietly from manuscript. They were delightfully written but lacked, perhaps, a distinctively didactic character. Authorities upon American history were cited, but little work on the part of the students seems to have been done, apart from attendance upon the lecture course. Mr. Greene's lectures were delivered first in the spring of 1872. At the time of Professor Tyler's appointment no department of American history existed in any university in the country; but it was the strong conviction of the new incumbent of this chair at Cornell that the time had come when the claims of our own national history were to be more distinctly recognized in the arrangement of historical instruction in American universities. This conviction has since been abundantly justified, not only by the steady growth of the new department here, but by the fact that the example thus set by Cornell has been followed by many other universities, with the probability that it will in the course of time be followed by them all.

In the study of American history, Professor Tyler holds that while the method should be thoroughly scientific its object should be practical. He says: "To this extent I believe in history with a tendency. My interest in our own past is chiefly derived from my interest in our own present and future, and I teach American history, not so much to make

historians as to make citizens and good leaders for the State and Nation. From this point of view I decided upon the selection of political topics for special study. At present I should describe them as follows: The native races, especially the mound builders and the North American Indians; the pre-Columbian discoveries; the origin and enforcement of England's claim to North America, as against competing European nations; the motives and methods of English colony-planting in America in the seventeenth and eighteenth centuries; the development of ideas and institutions in the American colonies with particular reference to religion, education, industry and civil freedom; the grounds of intercolonial isolation and intercolonial fellowship; the causes and progress of the movement for colonial independence; the history of the formation of the national constitution; the establishment and growth of political parties under the constitution; the history of slavery as a factor in American politics, culminating in the civil war." Professor Tyler emphasizes the use of the historical library by the students.

On June 18, 1891, it was resolved by the trustees that steps be taken for the establishment of a Department of History, Political and Social Science, and General Jurisprudence in Cornell University. Professor Charles Kendall Adams of the University of Michigan was engaged as lecturer on the constitutional history of Europe, and Professor Herbert Tuttle as non-resident lecturer on international law for two years, his duties to consist of a course of lectures to be delivered during one term, of three months, in each year. At a subsequent meeting, Professor Henry C. Adams of the University of Michigan was elected professor of political economy for one year. These were the preliminary steps taken in President White's absence, but upon his recommendation, to enlarge and give efficiency to the proposed department.

Professor Adams was the successor of President White in the University of Michigan. An industrious, laborious scholar, systematic in work, his instruction exhibited these characteristics.

The following courses in history were arranged:

1. General history, ancient, medieval and modern, with special reference to the political and social development of the leading nations.
2. The constitutional history of England, as that which has most strongly influenced our own.
3. The comparative, constitutional and legislative history of various modern states, as eliciting facts and principles of use in solving American problems.

4. The history, political, social and constitutional, of the United States, with a systematic effort to stimulate the students to original research into the sources of our national history.

5. The philosophy of history as shown by grouping the facts and thoughts elicited in these various courses.

The field of instruction assigned to Professor Tuttle was enlarged to embrace theoretical and systematic politics. Under theoretical politics were treated primitive societies, and under systematic politics, the States in their constitutional organization, legislation, administration, and civil-service methods, justice, revenue, military system and a comparative study of state governments. It was the purpose to make the students acquainted in a scientific sense with the true principles of state organization and practice, as well as with the existing institutions of the great civilized states. Under international law, the history and literature of the law of nations, the rules of war, neutrality, prizes, embassy, forms of diplomacy, the history of American diplomacy, together with discussions of some of the more famous international controversies in which the United States have been engaged, were treated. It was the design, that these two courses in theoretical and systematic politics, and in international law should be given in successive years.

The subject of American law and jurisprudence in the proposed course was assigned to Professor Wilson.

Systematic instruction in political economy with the aid of text-books was given by Professor Wilson, and lectures on the science of finance, embracing a study of the comparative financial administration of the various constitutional nations, and of the various sources of public revenue, were given by Dr. Henry C. Adams.

General history was treated in three periods of Greek and Roman, medieval and modern by President White, Professor C. K. Adams, Assistant-Professor Perkins and Instructor Burr. In 1883, Professor Tuttle was made associate-professor of the history and theory of politics and of international law; in 1887, professor of political and municipal institutions and international law, and, upon the formation of the President White School of History and Political Science in 1890, professor of modern history; Assistant-Professor Burr was made associate-professor, and later of ancient and medieval history; and soon after, Professor Dr. J. W. Jenks was appointed professor of political and social institutions and of international law.

Upon the election of President Adams to the presidency, he assumed also the professorship of history. Extended courses of lectures were given by him upon the theories and methods of English government, the political history of England since the Napoleonic wars, the rise of Prussia, the political and social history of Europe during the Middle Ages, the Renaissance, and the period following the French Revolution.

President Adams retained the position of professor of history until the close of the year 1888-89, when the increasing executive duties which devolved upon him caused him to resign this position. During the year 1887-88 Assistant Professor Horatio S. White gave instruction in history in branches in which instruction had been given previously by President White.

President White's interest in everything that concerned the whole being of society led him to the study of sociology and in his final report he recommended a course of practical instruction calculated to fit young men to discuss intelligently such important social questions as the best methods of dealing practically with pauperism, intemperance, crime of various degrees and among persons of various ages, insanity, idiocy and the like. This was one of those germ ideas which the president presented in the original "plan of organization," which it was impossible to realize for many years.

In pursuance of this suggestion Mr. Frank B. Sanborn, who had been for many years Secretary of the Massachusetts Board of Charities and of the American Social Science Association, was engaged to deliver a series of lectures annually upon the subjects here presented. He arranged also visits on the part of his students to the various State charitable institutions in the vicinity, to the Reformatory in Elmira, the insane asylum at Ovid, and the State Prison in Auburn. The attention of the students was thus called to the great need of legislation in behalf of the unfortunate classes and to the history of previous experiments in ameliorating their condition, and to the best methods of accomplishing the highest philanthropic purposes.

JOURNALISM.

The establishment of a course in journalism in the university was a favorite idea of President White. Recognizing the power of the press, he believed that it would be wise to extend facilities to students to

prepare directly for the profession of journalism. In pursuance of his plan, courses of lectures were delivered at different times in the university. Professor Fiske, who had been devoted to journalism for a number of years, delivered a course of lectures mainly upon the practical side of the journalist's profession. He discussed the arrangement of the matter in the newspaper and incidentally reviewed in a very suggestive way the methods of the leading journals; the special qualities and gifts of different men; the place of editorial comment; correspondence; foreign and local news in a popular journal. The Honorable James Brooks delivered four lectures, beginning May 25, 1880, based upon his own extended and successful experience in newspaper life. Mr. Charles E. Fitch delivered a course of five lectures in May, 1886, devoted mainly to the history of journalism in this country. Later, Professor Brainard Gardner Smith added to his regular duties a course in journalism in which, with the practical experience of a newspaper man, he sought to discuss the methods of a metropolitan daily and to give the students of his class practical drill in reporting actual and fictitious events. Members of the editorial boards of the college papers took great interest in these exercises. These young newspaper men not only used all the advantages placed at their disposal, but they published in the press of which they were correspondents a description of the system here in vogue. In consequence, widespread comment and discussion were aroused upon the possibility of successful instruction in journalism. On one side, it was held with great truth that the preparation of a journalist consisted primarily in the symmetrical development of all his powers; and secondly, in an intelligent acquaintance with the subjects discussed in the press, such as history, political economy, sociology, political institutions and constitutional law. It was urged still further that journalism was a craft, which could only be attained by practice, by experience in the various branches of a newspaper office. Many graduates of the university who had attained prominence as editors of leading journals in New York expressed this view. The relation of journalism to rhetoric and composition was maintained by some. It was thought that the power to write interestingly and graphically might be acquired by special training in the university, and the student be thus prepared to enter intelligently upon the practice of his profession. The demand for instruction in work in definite subjects, and the limited time available for essential studies, led to the practical abandonment of this experiment.

POLITICAL SCIENCE.

From the foundation of the university until the year 1880, there was no separate department of political science. Instruction in the subjects now embraced in that department was in the hands, so far as the resident force of instruction was concerned, of Dr. William D. Wilson, professor of moral and intellectual philosophy, who delivered a course of lectures on political economy one term each year. He published in 1875, chiefly for the use of his class in political economy, a treatise entitled, "First Principles of Political Economy with reference to Statesmanship and Progress of Civilization." In and after the years 1875-76, Dr. Wilson delivered also, one term each year, a course of lectures on the constitution of the United States, and American jurisprudence, this course taking the place of lectures on constitutional law, that had been delivered from 1868 to 1875 by non-resident Professor Theodore W. Dwight of New York city.

The department may be said to have been organized in 1881 when a four years' course in history and political science was established, leading to the degree of Doctor of Philosophy. In 1883, Professors Adams and Tuttle were made resident associate professors of political economy and political science respectively, and the work of the department was enlarged to include additional courses in systematic politics, in public finance, and further, in 1884, courses in practical economic questions. During the year 1884, Mr. Ellis H. Roberts delivered a course of lectures on the tariff, which were published the next year in book form, under the title, "Government Revenue."

In the years 1885 and 1886 courses of lectures on diplomacy and international law were delivered by the Hon. Eugene Schuyler, which were published in 1886 under the title of "American Diplomacy and the Furtherance of Commerce." The same year Professor Henry C. Adams published his book on "Public Debts: A Study in the Science of Finance." Dr. Wilson was elected professor *emeritus* at the close of this year (1885-86). In 1887, the work in history and political science was grouped under the title of the President White School of History and Political Science, and in accordance with the conditions of the organization of the school, a fellowship in political and social science was established.

Work in social science was begun in 1887 by Mr. Frank B. Sanborn, who gave a term's lectures each year on problems in social science,

which lectures were supplemented by class visits to various charitable, penal and reformatory institutions in the vicinity of Ithaca. This work was kept up by Mr. Sanborn until the year 1889, after which time for two years somewhat similar work was carried on by Professor C. A. Collin.

In 1887, Professor H. C. Adams, all of whose time was required at the University of Michigan, gave up his work at Cornell, and the following year work in political economy was given by Mr. Frank H. Hodder. Professor Tuttle was made professor of the history of political and municipal institutions and of international law. In 1888, Professor E. Benjamin Andrews was appointed professor of political economy and finance, but resigned after one year's work to accept the presidency of Brown University. During his year's residence he had printed outlines of his course of lectures for the use of students, which were afterwards gathered into book form under the title of "Institutes of Economics." Mr. Hodder again took charge of the work in economics for one year, when, in 1890, Professor J. Lawrence Laughlin was appointed professor of political economy and finance, and the work of the department was further strengthened by the appointment of A. C. Miller as associate professor of political economy and finance. At this time, too, graduate work in the department was strengthened by the establishment of two fellowships. In 1881, Professor Tuttle, having been made professor of modern European history, gave up the work in political science. Professor J. W. Jenks was called to a chair of political, municipal and social institutions to do this work and that formerly done by Professors Sanborn and Collin.

In 1892, Professors Laughlin and Miller resigning to accept positions in Chicago University, the departments of economics and finance and political and social institutions were combined into one, with a teaching force consisting of Professor Jenks, Associate Professor Edward A. Ross, Assistant Professor Walter F. Willcox and Dr. Charles H. Hull, Professor Jenks being granted leave of absence for the year. In 1893 Professor Ross resigned to accept a position at Leland Stanford, Jr., University; Dr. Hull was promoted to an assistant professorship, and Dr. L. S. Merriam was appointed instructor in political economy, the department now having four men whose full time was given to the work. The sad accident by which Dr. Merriam lost his life by drowning in Cayuga Lake checked the work of the department in part, but

most of Dr. Merriam's work was carried on by Professor Hull and the fellows in the department, Messrs. T. F. Carver and E. M. Wilson.

In the spring of 1894 Mr. Frank Fetter was appointed instructor in political economy. Though the work of the department is conducted as a unit, so far as it is practicable, each of the different teachers devotes his time to some special branch of the work. Professor Jenks gives his time chiefly to the work in political science and politics; Professor Willcox has charge especially of that in social science and statistics; while Professor Hull and Dr. Fetter conduct, in the main, the work in political economy and finance. In the year 1893-94 a new course in the mathematical methods of investigation in economic and social science was instituted by Professor Oliver for the especial advantage of advanced students who had had good mathematical training. The department is further strengthened by the work in international law and jurisprudence, and in constitutional law, given by Professors Huffcut and Hutchins of the law school.

XIV.

MATHEMATICS AND PHYSICS.

MATHEMATICS AND ASTRONOMY.

THIS department was under the wise direction of Professor Evan Wilhelm Evans until within a few months before his decease in 1874. He was proficient not only in mathematics but in geology and botany. He is remembered as a man of few words, but of a remarkably sound and independent judgment that carried great weight in the faculty councils, and as an acute and thorough student, a philosophical and original thinker, a firm and loyal friend. The best of his published work in mathematics is his "New method of solving cubic and trinomial equations of all degrees;"¹ it is very suggestive, and follows quite different lines from the usual methods; but the fuller statement of it planned by him was prevented by his failing health. His unpublished university lectures on modern synthetic geometry were elaborate and beautiful, and marked at the time almost a new departure for American colleges.

¹ Proceedings of University Convocation, 1870.

Characteristic of his instruction or policy were: the remarkable power of concentration with which he would follow others' work without using his eyes, his uniform preference for oral above written examinations, and his habit of taking a calculus class over the same ground with two successive authors for the sake of the cross-light.

With Professor Evans were associated here, at one time or another, Assistant-Professors Ziba H. Potter, William E. Arnold, Henry T. Eddy, William J. Hamilton, since deceased, Lucien A. Wait, and J. E. Oliver, and Instructor O. H. P. Cornell. The chief branches taught were algebra beginning with quadratics, plane geometry, solid geometry, trigonometry with navigation and mensuration, analytic geometry, calculus, synthetic geometry, and descriptive astronomy; analytic geometry occupying one or two terms, calculus three terms, and each of the other subjects one term, for commonly five hours per week. There was also land-surveying, for students in agriculture and other non-technical courses. Algebra, plane and solid geometry, and trigonometry were required studies in all courses; astronomy in the course in science; analytic geometry, calculus and synthetic geometry, in engineering, mechanic arts and architecture. Thus more of fine mathematics was required in the university then than now, but an offset, except as to advanced mathematics in the technical courses, is in the increased entrance requirements and in the various electives now offered.

The requirement of quadratics for admission was made in Professor Evans's day, that of plane geometry for all courses, and of solid for the technical, came later, and by degrees.

From 1873-4 on, the department has been administered, first by Professor Oliver and afterwards by Professors Oliver and Wait. They have been ably seconded by Associate-Professor George William Jones, Assistant-Professors William E. Byerly, James McMahan and Arthur S. Hathaway, and Instructors George T. Winston, Madison M. Garver, Morris R. Conable, Charles A. Van Velzer, Duane Studley, George E. Fisher, Charles S. Fowler, Walker G. Rappleye, John H. Tanner, Paul S. Saurel, and William R. Shoemaker. Four of the professors, and five instructors, remain to-day; most of the others have become professors or presidents in other colleges, and several of these have achieved eminence.

The work of the department to-day, like the earlier work out of which it has grown, contemplates three great uses: 1. To help the average student in developing certain powers and habits which every good

citizen and good thinker requires, namely of sustained, exact, candid independent reckoning, even when the subject-matter is general or abstract; of conscientiously scrutinizing a plausible argument, both in detail and in its general course; of imagination, to grasp as a whole a complex concept or scheme of thought; of inventiveness as to methods and possible relations; of applying theory to practical problems; of precision and clearness in stating one's own convictions and the grounds of them. 2. For those who wish to make pure and applied mathematics a specialty, to give some outlook over its different fields; and to fit these students for teaching, or for home reading and investigation, or for study at European universities. 3. To meet the needs of students in various branches of engineering, physics, and sociology.

The endeavor is not usually to cover all the ground in a given field, but to master the fundamental difficulties of concept and method, and secure whatever peculiar culture this implies,—relying more upon insight and origination than upon memory, and making all necessary memory-work as philosophical as may be. Attention is also given to the criticism of methods and their motives, methods suggested by general considerations being preferred; to the concrete interpretation of important steps as well as of results; and to the separation of symbols and their laws from the particular subject-matter, so that either may be studied separately. Whether instruction be given by text-books with recitations and problem-working, by written exercises and examinations, or by lecture, seminary and directed reading, the class are regarded rather as the teacher's fellow-students than as mere recipients of instruction.

Supplementary to the usual college curriculum of pure mathematics, including calculus, electives are at present offered in geometric, algebraic and trigonometric problems, determinants and theory of equations, probabilities and least squares, modern analytic and synthetic geometry, advanced calculus, differentiated equations, finite differences, quantics, function-theory, theory of numbers, and mathematical essays meant partly as studies of style; also, in descriptive and dynamic astronomy, rational mechanics, potential theory and special harmonics, and the mathematical theories of fluid motion as applied to meteorology, and of sound, light and electricity. There is also a seminary for the discussion of fundamental methods in algebra; one in mathematical pedagogy, to consider ideals and methods in mathematical study and writing as well as in teaching; one for application of mathematics to economic and

social problems; and one, held in connection with the department of chemistry beginning with 1894-5, for the mathematical study of physical chemistry.

The number taking these various electives as undergraduate, graduate or special students has about kept pace with the general growth of the university; though the splendidly equipped technical courses on the one hand and the admirable scientific and humanistic work done here on the other hand, offer strong counter attractions. For, in the community at large, mathematics is still thought of merely as a good logical drill, and a key to the physical sciences with their applications. One great mission of the mathematical department here, as elsewhere, is to show that in healthily developing the geometric and philosophic imagination; in awakening an intelligent interest in the grand systems of worlds amid which our own is placed, as well as a sense of the beauty of purely intellectual relations; in adding definiteness to certain metaphysical concepts; and in that correlation of the abstract with the concrete and with the certain which will help to cure the prevalent distrust of ideals, mathematical studies have peculiar educational and even religious values that could ill be spared.

In the equipment of the department are now many of Brill's beautiful and useful models, and others are being added. The University Library has some thousands of books on astronomy and pure and applied mathematics, besides most of the chief American, English, French and German journals, and the transactions of many scientific societies. A steady growth is assured by the Sage Library fund, so that in time the collection of mathematical classics and sources will have become reasonably complete, thus facilitating kinds of work that were impossible in the university's earlier days.

THE DEPARTMENT OF PHYSICS.

The Department of Physics was one of those organized at the opening of the university. The first incumbent was Professor Eli W. Blake now professor of physics in Brown University. Professor Blake was succeeded after two years of service by Professor John J. Brown, later of the University of Syracuse, who was followed, after one year, by Professor Loomis who served but two terms, and resigned in March 1872. After a short period, during which the chair was not filled, instruction in physics was given by Professor Morris, Assistant-Professor Eddy and others, William A. Anthony, Ph. B., a graduate of the Sheffield

Scientific School of Yale University, was appointed to the professorship. Professor Anthony had previously filled similar positions in Antioch College, Ohio, and in the Agricultural and Mechanical College of Iowa. Under Professor Anthony, physics soon took a prominent position among the subjects of the university curriculum. Laboratory instruction was almost at once begun. The quarters assigned to physics in 1873 consisted of a small lecture room in the south wing of McGraw Hall, with a small ante-room under the raised seats, which was intended to serve as apparatus room, professor's office and general laboratory. Under the vigorous administration of Professor Anthony, the needs of the department soon outgrew these cramped quarters, and various rooms were obtained on the upper floors, and in the basement of White and Morrill Halls.

The equipment of the department during all the earlier years of the university was of a meagre description, being in the main upon a par with that which might have been found in most of the smaller colleges of the country during that period of our educational development. There were a few noble pieces of illustrative apparatus for lecture room purposes, which had been purchased by President White, but the collection included no instruments of precision. This condition of affairs lasted, subject only to such amelioration as could be attained by the indefatigable industry and the mechanical skill of the head of the department and of his assistant, George S. Moler, who, from the time of his graduation in 1875, became a valuable attaché, serving successively as laboratory assistant, instructor and assistant-professor.

In 1881, the Board of Trustees decided to build a physical and chemical laboratory combined. Franklin Hall was the result of that action. To the department of physics the lower floors and basement of this large four-storied building of brown sandstone were assigned, and a considerable sum of money was appropriated for the purchase of a suitable equipment. Professor Anthony spent some months in Europe in the summer of 1881, in selecting and purchasing apparatus. Many important instruments were, however, made in the United States, notably a large and very substantial comparator, designed for the department by Professor William A. Rogers, a dividing engine designed by the same physicist, a standard clock by Howard, and a large spectrometer by Fauth, of Washington, together with chronographs. The building of this laboratory marks an epoch in the history of the department, but a more important period was about to begin in the inaugura-

tion, two years later (1883), at the instance of Professor Anthony, of a course in electrical engineering. There was much opposition to the introduction of what was at that time a subject unrecognized upon the lists of the technical schools, and it was with difficulty that the Board of Trustees could be persuaded to sanction such an experiment. The course once announced, however, its success was immediate and marked. The Register of the following year, 1883-4, shows 12 students in electrical engineering; that of the tenth year following, 1893-4, contains 350 students, 28 of whom are in post graduate courses. In 1883, the instructing force of the department consisted of Professor Anthony and Assistant-Professor Moler. In 1893, it consisted of the head of the department, Professor Edward L. Nichols who had succeeded Professor Anthony in 1887, at which time the latter resigned his chair to engage in practical work in electrical engineering, of three assistant-professors, G. S. Moler, Ernest Merritt and Frederick Bedell, and of seven instructors and assistants. During this last decade the growth of the technical schools connected with Cornell University so increased the number of students having required work in chemistry and physics, that it became necessary to build a new chemical laboratory and to assign the whole of Franklin Hall, together with the adjoining structure known as the chemical annex, to the latter department. In the year 1893-4, there were over six hundred undergraduates who were receiving instruction in laboratories and class rooms in the department of physics, together with some forty graduate students who were engaged in advanced work and in investigation. In 1893, another important step in the history of physics of Cornell University was taken in the foundation of the Physical Review, a bi-monthly journal devoted to original work in experimental physics. This journal is edited by Professors Nichols and Merritt and is published for the university by Messrs. Macmillan & Co., of New York.

XV.

NATURAL SCIENCE.

THE DEPARTMENT OF CHEMISTRY.

The Department of Chemistry was one of the first in which an appointment was made. At the sixth meeting of the Board of Trustees,

held September 26, 1867, four professors were elected, among them Dr. George C. Caldwell as professor of agricultural chemistry and James M. Crafts as professor of general chemistry. Professor Caldwell was a graduate of the University of Göttingen, and had also studied the methods of instruction in the model college of Cirencester, England, and was widely known for his investigations in agricultural chemistry. Professor Crafts was a graduate of the Lawrence Scientific School, and had afterwards spent several years in study in France and Germany, where he had published several original investigations of great merit. At the time of his appointment he was an instructor in the Lawrence Scientific School. Since then he has made many brilliant investigations, which have caused him to rank among the most eminent of American chemists; at the present time he is a professor in the Massachusetts Institute of Technology. Soon after the appointment of these professors of chemistry, they prepared lists of the most important English, French and German standard works in their department and of the leading chemical periodicals, which were purchased by the university abroad through President White, and formed a portion of the equipment at the opening of the university. Many complete sets of chemical journals were also obtained, thus constituting a valuable library for investigation, from the beginning. Chemical apparatus was also ordered, and arrived from Europe in the summer of 1868. The boxes which contained these scientific treasures were stored and opened in the northwest basement of what is now known as Morrill Hall. Professor Caldwell presents a graphic account of a professor's life in those early days. At that time he occupied a house partially completed near the head of Buffalo street. "To reach the university it was necessary to climb a hill without sidewalks; to skirt Cascadilla, passing an old weather-stained mill which stood behind it, and avoid skillfully the debris around these buildings; to descend into a gorge by ladders, and to risk one's life in crossing planks; to wind through the woods upon the north bank, and then pass through fields and over two successive ravines, and clamber over fences, before the solitary building which constitutes the university was reached. The new professor found his earliest task in the manual labor of unpacking these European purchases. The first chemical laboratory was established in the basement of Morrill Hall, in the large room on the north side of the central entrance. The private laboratory of Professor Crafts, for his own and for the special work of his students, consisted simply of one short table

at the end of this room, with a shelf and two capacious drawers below. Professor Caldwell's laboratory consisted of a similar table at the other end of the room. All the water supply was brought in pails, and the waste received and carried out in jars. The only ventilation was through chimney flues, and what did not escape through this uninviting exit ascended to the library room, which was directly above. Lectures in agricultural chemistry were given in a small basement room adjoining this laboratory, and the lectures on general chemistry in the large room on the other side of the middle hallway." Thus these pioneers of education passed through hardships, the immortal humor of which is now their chief compensation. "During the fall and winter, a large wooden building was erected near the middle of what was then the campus, and in the spring vacation the chemical department forsook its narrow and uncomfortable quarters in Morrill Hall for its new rooms in this wooden structure, and I have no doubt that those who were left behind were as glad to have us leave as we were to get away. Of room we had an abundance in our new quarters, but of comfort, not so much. It was expected that we might occupy them for four or five years, and, of course, with such expectations, the building was cheaply constructed, and all its discomforts were endured for ten years or more, instead of the limited time originally anticipated. The building was at first occupied by the departments of mechanical engineering, botany and physics, as well a chemistry. One by one these departments were transferred to better quarters, until finally it became the exclusive possession of the chemical department for a few years. Then the department of civil engineering moved into it, and was in its turn left its sole occupant, when in 1882 the chemical department moved into the second and third stories of Franklin Hall, where, for the first time, it was accommodated in quarters especially planned and constructed for its use; but this building soon became too small for the departments of physics and chemistry and finally, in 1890, the latter department moved into Morse Hall, which had been erected for its exclusive use. This last move will undoubtedly end its wanderings on the campus." This new building was called Morse Hall in honor of the inventor of the magnetic telegraph, Mr. S. B. F. Morse. The plan of this new chemical building makes it one of the amplest and best arranged of any structure devoted to similar purposes in America. Professor Spencer Baird Newbury was at that time acting professor of organic and applied chemistry, and later of general, organic and ap-

plied chemistry. He had an enthusiastic interest in the equipment of this new building and, in company with Professor Caldwell, carefully studied and designed its general arrangement.

The scope of instruction in chemistry has been greatly widened. At first, only general, analytical and agricultural chemistry were taught, and laboratory practice was confined to analytic chemistry. A short time after the department was established in its first home, laboratory practice in general chemistry was introduced, suggested by the evident usefulness of such practice for a better understanding of the principles of elementary general chemistry, and also on account of the option of chemical laboratory practice, which was allowed for a few years in place of a part of the mathematics, which had hitherto been required in the general courses. Some kind of work in general chemistry seemed to be far more appropriate for this option than the more technical work of analytical chemistry. The inequality of the option of work in elementary chemistry for mathematics soon became so evident that it was given up after a very brief trial, but laboratory work in general chemistry has been continued up to the present time. It was at first required only of those who later have analytical chemistry in their courses of study, but is now required of all who take the course in general chemistry. Technical chemistry was also added in the history of the department, but was discontinued after two or three years, on account of the resignation of the professor who first suggested its introduction, and taught it. Organic chemistry was taught by lectures, and laboratory practice added later, together with metallurgical chemistry. The latest addition to the field of instruction in this department consists of courses of instruction in the most advanced field of physical chemistry. A steady advance has thus been made along all these special lines of work in chemistry by the addition of new and more advanced courses, so that now thirty-one are offered in the department, and in the list of courses for 1894-5, the number will be increased to thirty-five. Professor James M. Crafts resigned at the end of the first year, and Professor Charles A. Schaeffer was elected professor of analytical chemistry and mineralogy, June 30, 1869. Professor Schaeffer was a graduate of the University of Pennsylvania and also of the University of Göttingen, Germany. He remained connected with the department until his election as President of the University of Iowa in 1887. During the year 1886-7 he acted as dean. One year later, Professor Chester H. Wing was elected to the chair of chemistry as applied to manufactures. Pro-

essor Wing had graduated with distinguished honor at the Lawrence Scientific School, and had also had practical experience as a manufacturing chemist. He was connected with the university from January, 1870, to 1873, and he delivered subsequently, each year until 1880 a series of lectures upon organic chemistry. After leaving this university he was appointed to a professorship in the Massachusetts Institute of Technology where, through his efforts, one of the largest departments for instruction in chemistry in the country was created. A. A. Breneman was appointed assistant professor of industrial chemistry in 1875 and professor in 1879, which position he held until 1882. Professor Breneman made many interesting investigations during his connection with the university, and later, as consulting chemist in New York, valuable discoveries of colors available for use in the manufacture of pottery. Dr. Spencer Baird Newbury, a graduate of the School of Mines, and later a student in the University of Berlin, was made assistant professor of general chemistry, mineralogy and assaying in 1882, and acting professor in 1886, which position he filled until 1892. Professor Newbury was an enthusiastic student of his chosen branch, and took great pleasure in the development of chemistry as applied to photography. At the exposition in Paris of 1889 he was appointed by the United States government to make the report upon certain branches of chemistry, and later he was a representative of the State of Ohio, and judge in the Chicago Exposition of 1893. Assistant Professors William R. Orndorff, Ph. D., Louis Munroe Dennis, Ph. B., Joseph Ellis Trevor, Ph. D., have contributed by investigation and instruction to extend the reputation of the department.

BOTANY.

The Botanical Department was organized at the opening of the university in October 1868. Professor Albert N. Prentiss, then a professor in the Michigan Agricultural College, from which institution he had graduated in 1861, had been elected to the chair of botany, horticulture and agriculture, and placed in charge of the department. In the first general arrangement of courses of instruction in the university, the general and introductory course in botany was assigned to the spring term; but a more advanced course of lectures on systematic botany was offered for the fall term. This was attended by a class of four students who came from other colleges and had taken some botanical

work before entering the university. These lectures were given in what is now room 11, Morrill Hall. The university did not as yet possess botanical collections of any kind, so that the means for illustrating the lectures were very insufficient. Moreover, the lecture room could be used for botanical purposes only for the single hour of the days on which the lectures were given. There could not, therefore, have been any proper preparation for a scientific lecture, even though suitable material had been available. In the winter term, the work was practically a continuation of that above described.

In the spring term of the first year a general course of botanical lectures was offered, which was attended by 144 students. By this time the laboratory building, so called, a large wooden structure, designed more especially for the departments of chemistry and physics, had been partially completed, and two rooms were assigned to the use of the botanical department. These consisted of a small lecture room for special classes, and a smaller room for a laboratory and professor's study. As the lecture room was far too small for the class in general botany, the lectures were given in the chemical lecture room. The laboratory work for the large class consisted only of the study and determination of species of flowering plants of the local flora. No other place being available, this work was done in a large unfinished room in the north wing of the laboratory building. This room, still unfinished, was used in this way in the spring term for three years. At a later period this room, with others, was finished for the use of the civil engineering department.

During this first spring term, in addition to the botanical work, a course of lectures on horticulture was given to a class of special students.

During the second year, 1869-70, the facilities for instruction were very considerably increased. Collections of models and diagrams, which had been purchased in Europe, began to arrive during the latter part of the previous year, and were now available for use. The small lecture room and the small and meagerly equipped laboratory were still employed by the department. In the fall term a course of lectures was given on systematic botany, which could now be presented in a manner superior to that of the previous year. Some beginnings were also made in special laboratory work. In the spring term there was an enrollment of 225 students for the general course. The lectures were given in the large lecture room on the upper floor of the building now known as White Hall. Owing to inadequate facilities for so large a class,

and the want of an assistant, no laboratory work was undertaken; but all possible efforts were made to interest the members of the class in the study of the local flora.

No lectures were given in the fall term of 1870-71, the professor of botany being absent in Brazil with the Cornell Exploring Expedition. This expedition was organized by Professor C. F. Hartt for the purpose of making studies and collections in natural history. The party, made up of the two professors named, and about ten students, sailed from New York the latter part of June and returned early in the following January. The principal explorations were made in the valley of the Amazon for a distance of some 400 miles above Pará, and on two of the chief tributaries of the main stream, the rivers Chingu and Tapajos. The advantages of this expedition to the botanical department consisted chiefly in the opportunity for the professor of botany to make an extended field study of tropical vegetation, and a considerable collection of material for the herbarium and museum.

Lecture work was resumed in the winter term, and in the spring the general course was given to a large class. Laboratory and field work were attempted, but systematic work in the department was accompanied by serious inconveniences. The collections and illustrative material were in the south wing of the chemical laboratory, the lectures were given in the room at the top of White Hall, while the laboratory work was done in the unfinished room in the laboratory. The labor of carrying the illustrative material needed for the lectures from one building to another across the campus and up several flights of stairs, of conducting the whole work of the department in practically three different buildings, by the professor in charge without any assistance except some undergraduate help in the laboratory, illustrate the extreme inconvenience and primitive conditions which prevailed during these earlier years.

The event of the year 1871-72 was the bringing together of the different branches of the department under one roof. Sibley College was dedicated June 21, 1871, and through the courtesy of Professor J. L. Morris, dean of the department, some rooms not needed for the time being for his work, were temporarily assigned to the use of the botanical department. Those rooms were the large lecture room on the second floor south, and the corresponding room on the floor above, used for a laboratory. A smaller room was available as a study and office for the professor of botany, and another small room for the stor-

age of a part of the botanical collections. The lecture courses offered were similar to those of previous years, but the conveniences for doing the work of the department were now much increased. A small number of advanced students were now engaged on special subjects, and the work in these lines began to show considerable improvement over previous years. During this year an instructor in botany was for the first time appointed, but only for the spring term. This officer was David S. Jordan, now President of Stanford University, then a senior at Cornell and a most enthusiastic and accomplished student of botany.

During these years, 1872-75, the department continued to occupy its quarters in the Sibley building. While the ground work was not greatly changed, some additional special courses were offered. In the spring term of 1873 a carefully organized course of lectures was given on Fungi to a class of fifteen students. The superior quality of the students who now elected special and advanced botanical work, is shown by the fact that several of the members of this class have since become well known naturalists, and at least seven have been, or now are, college professors. For the spring term of 1873 Mr. W. R. Dudley, then a junior and an excellent student in botany and other subjects in natural history, was appointed an instructor in botany to assist in the general laboratory work. He was again appointed for the spring term on the following year.

During this period the enthusiasm for botanical excursions and the study of the flora of Ithaca and vicinity, which had been a conspicuous feature of the work of the department from the beginning, became very prominent. Every ravine, marsh, hillside and wood was explored and the discovery of a species not previously recorded was hailed with great enthusiasm, not only by the discoverer, but by his companions in botanical study. Among the notable discoveries of the period was that of the ash-leaf maple, a tree not previously known as growing spontaneously within the limits of the State of New York. A number of specimens, some twenty or more, mostly small in size, were found in a small piece of undisturbed wood about two miles south of Ithaca. The discoverer was Mr. J. C. Branner, a botanical student of rare promise, who has since become a geologist of excellent reputation, and is now a professor in Stanford University.

The period from 1875 to 1888. In the fall of 1875 the department began its work in its present quarters in the south wing of Sage College. The corner stone of this building had been laid with appropriate

ceremonies on May 15, 1873, and the building was now ready for use. The rooms occupied by the department were a large lecture room, a professor's office and study, and a laboratory on the first floor; a museum 28x46 feet on the second floor, and on the third floor a number of smaller rooms used for pressing and mounting specimens for the herbarium, storage for duplicates and apparatus, and other similar uses. The total floor area thus occupied by the department was upwards of 6,000 square feet. The lecture room was handsomely finished in hard wood and provided with fixed seats with walnut arm rests for 156 students. By the use of chairs, the seating capacity of the room could be somewhat increased without undue crowding. The enrollment of some of the larger classes has been upwards of 175. The laboratory was lighted from the north, and adapted to microscopical as well as general laboratory work. In the museum were the general herbarium and other collections, for which suitable cases had been provided. Thus, after six years of pioneering, with inadequate but slowly improving facilities and the temporary occupancy of various buildings, the department found itself located in handsome quarters admirably adapted to its requirements.

Beginning with the fall of 1875, Mr. W. R. Dudley was regularly appointed instructor in botany to devote his entire attention to the subject, the previous appointment having been for a single term each year. At the beginning of the following year, 1876-77, he was appointed assistant professor. The scope of instruction was now somewhat increased, chiefly in cryptogamic subjects. In the spring of 1877 a course of instruction was given on mosses and algæ, and in the following autumn on ferns. Opportunities for special work were improved, and an increasing number of students was now conducting work of this kind.

Within five years of the first occupancy of Sage College the facilities for laboratory work had become inadequate for want of room, and the need of a green-house from which living plants could be obtained at all seasons of the year, was felt to be urgent. At this juncture the Hon. Henry W. Sage, who had already made princely gifts to the university, offered as a further gift the means for extending the laboratory and erecting a conservatory, the whole to cost \$15,000. Work was begun in the summer of 1881. The laboratory extension was of brick, 24x36 feet, two stories in height, and corresponded in architecture to the older building. The conservatory consisted of five connected glass

structures, of different heights and adapted to different temperatures, the whole range being in extreme dimensions 50x152 feet. These improvements were completed in the following spring, and were formally opened by appropriate exercises held in the botanical lecture room on the evening of June 15, 1882. Brief addresses were made by President White, Hon. Erastus Brooks and others.

These increased facilities for botanical work were of great moment. The available space in the phanerogamic and histological laboratory (on the first floor) was nearly doubled, and an office and study for the assistant professor of botany was provided. On the second floor was a well lighted laboratory, which has since been devoted wholly to cryptogamic work. The conservatories, which were built in the most substantial manner, proved to be admirably adapted to the uses for which they were intended, and soon began to afford material for work and illustration in all the courses of instruction offered by the department, as well as by affording opportunities for experimental work and investigations on the physiology of plants. In the fall of 1882 Mr. Robert Shore was appointed head gardener, and placed in immediate charge of the conservatories.

In 1886 the catalogue of the flowering plants of Ithaca and vicinity was published by Professor Dudley under the title, *The Cayuga Flora*. This important work was based upon the studies and explorations of the officers and students of the department from the beginning of the university, this being supplemented by special and critical work carried on for several years by the author. The field embraced in this flora is the territory drained by Cayuga Lake and its tributaries, of which Ithaca is approximately the center. The number of species and varieties catalogued was 1278. The catalogue proper forms a pamphlet of 140 pages, with two maps, and is preceded by an introduction of some thirty pages. The catalogue has been of great service to the department as a guide to explorations and field study; and the thoroughness of the work is shown by the fact that, although the field studies have continued to the present time with unabated interest, only a small number of species have been added to those listed in the flora.

For the year 1887-88, Mr. F. V. Coville was appointed instructor in botany, Professor Dudley being in Europe. Mr. Coville graduated at the Commencement of 1887, and had been a student of marked ability in botany throughout his university course.

1888-92. In the summer of 1888, the Agricultural Experiment Station, provided for by the act of Congress known as the Hatch bill, was established at the university. After due consideration the Station Council decided that some botanical investigations concerning the diseases of plants, especially those of fungous origin, ought to be undertaken in the interest of the station. This work was placed in the hands of Professor Dudley at his request, and the duties of cryptogamic botanist to the station assigned to him in the fall of 1888. To secure time for these new duties Professor Dudley was relieved of all work of instruction for one term, and a part of the work for the other two terms of the year. In connection with these changes, Mr. W. W. Rowlee who had graduated at the previous Commencement, was appointed instructor in botany.

The evidences of improvement and increased interest in botanical work during this period were encouraging. The actual as well as the relative number of students engaged in special work, and in research and investigation of a more or less difficult nature was greater than ever before. In the last year of the period sixteen graduate students besides a still larger number of special undergraduate students, mainly seniors, were taking work in the department.

A change of importance was made in the general course. Heretofore this course of three lectures per week had been given in the spring term. Beginning with 1890-91, the course was given in the fall and winter terms, two lectures per week being given. This change nearly doubled the time assigned to the general course, and was important especially in this, that it made it possible to devote the entire winter term to a course of lectures on the physiology of plants.

At the close of the collegiate year, 1891-2, Professor Dudley retired from the university in order to accept a professorship of botany in Stanford University.

At the beginning of this year (1892) Professor G. F. Atkinson was appointed assistant (and since associate) professor of cryptogamic botany in the university, and cryptogamic botanist to the Experiment Station. Professor Atkinson graduated from Cornell in 1885, and had occupied the chair of botany in the University of North Carolina, but at the time of his appointment was professor of biology in the Agricultural College of Alabama. His chief line of work had been in cryptogamic botany, and his investigations and contributions, especially in fungi and in fungous diseases of plants, had become widely and favor-

ably known. His familiarity with the subject, and a very considerable increase in laboratory equipment, now rendered it possible to add to the courses already established, an important course on the methods of study and culture of bacteriæ.

THE GENERAL PLAN OF INSTRUCTION.—In arranging the courses of instruction in the department, the obligations to provide general instruction for those who desire to begin the study of botany has been recognized from the first. This was demanded not only by the relation which the university bears to the State, but also by the fact that botany is not taught in all the schools of the State, and is adequately taught in only a few. No effort therefore, has been spared to make the general course as offered by the department in the highest degree effective. And this has been done for two reasons—to make the work as valuable as possible to those whose study of botany ceased with the general course, and to serve as an introduction to future courses for those who intend to pursue the subject still further, there have been, therefore, three lines of work constantly in progress; the general course; the advanced courses, in recent years usually eight to ten in number; and the special and largely independent work for the most advanced students. The plan, although not an ideal one for university work, has nevertheless been attended with some satisfactory results. The classes in the general courses have been very large, but the department has from the first attracted a considerable number of advanced and special students. Numerous theses for first degrees, and a number for advanced degrees, have been prepared, many of which have shown marked ability in original research. A portion of these have been published as contributions to botanical science. One of the earliest was the thesis of Mr. Hine (1877), an original study of the difficult and, at the time little known group, the Saprolegnieæ. This paper, which was published in the *American Microscopic Journal*, was illustrated with lithographic plates containing sixty-one figures.

A considerable number of the special students of the department have become successful naturalists, teachers and authors. A list of these would include the names which follow. Those receiving first degrees from the university are indicated by the dates of graduation. Most of the others have been graduate students, some of whom have received second degrees.

Atkinson, G. F., (1885) associate professor of cryptogamic botany, Cornell University. Arthur, J. G., professor of vegetable physiology, Purdue University. Ashe, W. W., botanist to the geological survey of North Carolina. Craig, Moses, professor

of botany in the Oregon Agricultural College. Coville, F. V., (1887) chief of the botanical division United States Department of Agriculture. Dudley William R., (1874) professor of botany, Stanford University. Densmore, H. D., professor of botany, Beloit College. Durand, E. J., (1893) fellow in botany, Cornell University. Hough, R. B., (1881) author of *American Woods*. Howell, J. K. Miss, (1888) assistant in botany, Barnard College. Kellerman, W. A., (1874) professor of botany, Ohio University. Lazenby, W. R., (1874) formerly professor of botany, now professor of horticulture, Ohio University. Mathews, C. W., (1891) professor of horticulture and botany, State College of Kentucky. Moore, V. A., (1887) assistant in bacteriology, United States Department of Agriculture. Millspaugh, C. F., author of *American Medicinal Plants*, now botanist to the Chicago Columbian Museum. Rowlee, W. W., (1888) assistant professor of botany, Cornell University. Schrenk, H., (1893) assistant in botany, Harvard University. Trelease, W., (1880) professor of botany, Washington University, and director of the Missouri Botanic Garden. Thomas, M. B., (1890) professor of botany, Wabash College. Yatabe, R., (1876) professor of botany and curator of the botanic gardens, University of Tokio.

Nearly all of these botanists are investigators and writers as well as successful teachers; but the list of books, monographs, revisions of genera or other groups, floras, and miscellaneous papers touching nearly all branches of botanical science, of which they are the authors, would be quite too long for presentation in this connection.

THE COLLECTIONS.—At the organization of the university, as already stated, there were no collections available for class-room or laboratory purposes. Models and charts, however, began to arrive from Europe at the close of the first year; but the first most important accession was a collection of herbarium specimens made by Horace Mann, jr., who had been a student and herbarium assistant of Dr. Asa Gray. This collection was purchased in 1869 by President White, at a cost of \$1,014 and presented to the university. There were upward of 7,500 mounted species, many of them represented by more than one specimen. The collection consisted mainly of flowering plants and ferns, and is especially rich in Sandwich Island plants. From these beginnings the collections have made a continuous growth. The general herbarium now contains some 15,000 mounted species; there are also many thousand duplicates; the local herbarium is nearly exhaustive of the species of the Cayuga flora; the cryptogamic herbarium contains from eight to ten thousand specimens, and there is a small garden herbarium of cultivated plants. In the museum are specimens of fruits, nuts, seeds, woods, fibres and various economic vegetable products. The department owns the Auzoux and Brendel models, the Achille Compte wall maps, the Kry charts and other diagrams, physiological apparatus, a lime lantern with 500 views, and a collection of some 800 microscopic

mounts. In the conservatories are a thousand or more species and varieties of living plants. The laboratories are equipped with thirty dissecting and compound microscopes, microtomes, reagents and the various appliances for microscopic and histological work. In the photographic rooms are cameras, photo-micrographic apparatus and other apparatus for applying photography to scientific purposes. In the cryptogamic laboratory are steam sterilizers, Rohrbeck's large thermostat with electric thermo-regulator, culture rooms and other appliances for bacteriological study and research.

THE DEPARTMENT OF GEOLOGY.

At the opening of the university the department of geology was entrusted to Professor Charles Fred Hartt, a native of Nova Scotia. He graduated at Acadia College in 1860, and had spent three years as a special student of geology under Professor Agassiz in Cambridge. For one year (1864-5) he was an assistant on the geological survey of New Brunswick. In 1865-6 he was geologist of the Thayer expedition to Brazil. Here he found an entirely new field of investigation, not only in geology, but in ethnology, physical geography and the languages, customs and lore of the South American Indians. He published numerous papers which showed the versatility of his genius, not only in geology but in ethnology. He was unwearied in mastering the languages of the Indians, and in acquiring the hidden treasures of their popular legends. In the brief period of his connection with the university Professor Hartt stimulated the scientific interest of numerous students who have since become famous in their chosen fields. In order to return for further investigation in Brazil, he organized in 1870 a company of professors and students, who volunteered to join him in a new expedition to Brazil. Among those who accompanied him were Professor Prentiss for the study of the tropical flora, and Messrs. Derby, Branner and Rathbun. In university history this expedition bears the name of the "Morgan Expedition," in honor of the Hon. Edwin Barber Morgan of Aurora, who contributed a considerable sum to defray its cost. These enthusiastic scientists spent the summer and autumn of 1870 in Brazil and returned laden with valuable specimens to enrich the university museums. Three years later, Professor Hartt was offered the position of director of the geological survey of Brazil and received leave of absence to superintend that work. He

filled the position from 1874 to 1878 but fell a sacrifice to his zeal for science on March 18, 1878.

During Professor Hartt's absence, Dr. Theodore Bryant Comstock, one of his pupils, filled the position of assistant professor of geology until 1879, when Dr. Samuel Gardiner Williams was elected professor of general and economic geology, and Dr. Henry Shaler Williams as assistant professor. In the following year, Dr. Henry S. Williams was made assistant professor of palaeontology, and in 1884, professor. In 1886, upon the resignation of Dr. Samuel G. Williams, Dr. Henry S. Williams was made professor of geology and palaeontology, with Mr. James F. Kemp assistant professor of geology and mineralogy. Professor Kemp resigned at the close of the university year 1890-91, in order to accept a position as professor of geology in Columbia College, at first as associate, and later as the successor of his teacher, the late Professor Newberry.

Dr. John Francis Williams, who had made a brilliant reputation as a petrographer by his studies in Europe and Arkansas, was elected to succeed Professor Kemp, but his work had scarcely begun when he fell a victim to a disease which he had contracted by overwork. In the winter of 1892, Mr. Ralph S. Tarr was appointed his successor, and in the spring of that year Professor H. S. Williams resigned his position as head of the department to accept a position at Yale, where he succeeded his illustrious teacher, James D. Dana.

Prior to the departure of Professor H. S. Williams, the courses of instruction in the geological department had been mainly in the lines of palaeontology and mineralogy, but after the resignation of Professor Williams, the former was necessarily dropped; and the latter work was continued, with some changes, under the direction of Instructor Arthur S. Cable. Courses in geology and physical geography were introduced, and it has been the effort of Professor Tarr to develop these branches and to introduce methods of instruction by means of field and laboratory work.

For the next year (1894-5) an entirely new plan of organization has been adopted, and, instead of a single department, three sub-departments have been created by the appointment of Mr. Gilbert D. Harris, assistant professor of palaeontology; Dr. Adam C. Gill, assistant professor of mineralogy and petrography, and Mr. Ralph S. Tarr, assistant professor of dynamical geology and physical geography. Mr. Eakle has resigned to go to Europe for study, and Mr. Stuart Weller,

the assistant in geology, will go to Yale to accept a similar position there. Mr. S. P. Carll will succeed Mr. Weller as assistant in geology and mineralogy.

The department is extremely well situated for instruction in palaeontology, since the university is built in the midst of a rich field of fossiliferous Devonian rocks. Moreover, there has been, almost continuously since the opening of the university, a palaeontologist in the department, and for the greater part of the time at the head of the department. Therefore the collection of fossils has grown to great size, and includes many typical and unique specimens. Aside from many smaller collections, there is the Farnum Jewett collection, purchased by Ezra Cornell at a cost of ten thousand dollars, and the remarkable Newcomb collection of recent shells, purchased at a cost of thirteen thousand dollars. Few universities in the country have more valuable collections of fossils, and yet there is much that is needed in this branch.

The department of mineralogy is also well supplied with collections, for, aside from the study series, there is the valuable Silliman collection, which is on exhibition in the museum. Of late years, owing to the development of new methods in the study of minerals and rocks, a department of mineralogy needs much expensive apparatus, only a part of which is at present owned by the department.

Upon the geological side there is much that is urgently needed. The collections of photographs, lantern slides, maps and models, need to be greatly enlarged to meet the demands of modern methods of instruction. But the chief need of this department is facility for pursuing field work away from Ithaca. While in some respects the region is admirably adapted to field instruction, there are numerous points of importance that are not illustrated in the vicinity. The geological instruction should, therefore, be supplemented by vacation courses in field work in the Appalachian formation, and it is earnestly hoped that the means for this may be forthcoming. The brilliant success of some of Professor Hartt's pupils depended largely upon the training in the field that they received under him in Brazil.

Since the first years of the university, the constant aim in the geological department has been to offer courses of a thoroughly scientific character, and to furnish to students training upon which a successful career in scientific investigation is based. That the effort has been successful is shown by the following list of names of students in this

department who have made geology a profession. This list does not pretend to be complete, but its length is surprising when the history of the department and the frequent interruption in its continuity are considered.

Branner, Dr. J. C., professor of geology at Leland Stanford Jr. University and formerly professor of geology in Indiana University, State geologist of Arkansas, etc., etc. Comstock, Dr. T. B., president of the University of Arizona and formerly assistant professor of geology at Cornell, assistant geologist on the Arkansas and Texas Geological Surveys, etc., etc. Curtice, F. Cooper, Department of Agriculture, formerly of the U. S. Geological Survey, etc. Derby, O. H., director of the Geological Commission of San Paolo, Brazil, formerly instructor in geology at Cornell, etc. Eakle, A. S., student at Leipzig, formerly instructor in mineralogy at Cornell. Fairchild, H. L., professor of geology at Rochester University and secretary of the Geological Society of America. Gurley, W. F. E., State geologist of Illinois. Harris, G. D., assistant professor of palæontology at Cornell, formerly assistant in the National Museum, and on the Texas Geological Survey, etc. Hill, R. T., U. S. Geological Survey, formerly professor of geology at the University of Texas, assistant on the Arkansas and Texas Geological Surveys, etc. Holmes, J. A., State geologist of North Carolina, professor of geology and botany, University of North Carolina. Marsters, V. F., professor of geology Indiana State University, and formerly instructor of geology at Cornell. Prosser, C. S., professor of geology, Washburn College, formerly instructor of geology at Cornell, etc. Simonds, F. W., professor of geology in the University of Texas, formerly instructor of geology at Cornell, etc. Turner, W. H., assistant geologist on the U. S. Geological Survey. White, D., assistant U. S. National Museum and U. S. Geological Survey. Weller, S., assistant in geology, Yale College and formerly assistant in geology at Cornell. Van Ingen, G. D., assistant at Columbia and formerly museum assistant at Cornell.

VERTEBRATE ZOOLOGY.

THE Department of Vertebrate Zoology includes physiology, neurology, embryology, histology and anatomical and microscopical methods.

The present staff comprises a professor of physiology, vertebrate zoology and neurology, Burt G. Wilder, B. S., M. D.; an associate professor of anatomy, histology and embryology, Simon H. Gage, B. S.; with two instructors, Pierre A. Fish, B. S., D. Sc., and Grant S. Hopkins, B. S., D. Sc., assigned respectively to the two groups and subjects embraced in the titles of the two professors.

Apart from veterinary science, the zoological division of the university was at first entrusted to a single professor, with the title of professor of comparative anatomy and natural history, and the department represented by him was first called the Medical. This was soon changed

to Anatomical. The title of the professor was made professor of physiology, comparative anatomy and zoology; later it was changed to its present form, indicating the three courses personally conducted in the three terms of the college year. In the earlier years instruction in invertebrate zoology, excepting insects, was shared, in part, with the professor of geology and palæontology.

In 1871-2 the course in the winter term was devoted to comparative neurology, and that in the spring to human embryology, thus, it is believed antedating the period of such specialization outside of some of the larger medical schools. A course in experimental physiology of muscle and nerve was given in 1880 and 1881, but abandoned for want of suitable apparatus. The anatomical laboratory was a basement room in the south end of Morrill Hall. After the first two years an adjoining room was available, and later a small room on the third floor. Upon the completion of McGraw Hall in 1871, the only laboratory space was found beneath the rising seats of the lecture room, which was reserved for the head of the department and special students. Later the basement was fitted up for general laboratory work. There are now in the north wing separate rooms for the professor and associate professor; also a histological laboratory. The horizontal division of the lofty lecture room enables it to be used for practicums as well as lectures, and provides four rooms above for storage and special work.

At first the large room on the fourth floor of Morrill Hall was used for lectures in common with other departments. The lecture room in McGraw Hall was shared for many years with the geological department, and is now used in the fall and spring for the courses in invertebrate zoology and entomology.

The Auzoux models and other objects constituted the nucleus of the museum, and were first accommodated in a room on the second floor of Morrill Hall. Until recently the vertebrate collections have occupied cases in McGraw Hall, joining and commingled with cases containing collections of several other departments. Under these circumstances no proper scientific arrangement has been practicable.

Besides the general effect of the teachings, writings and example of the elder Agassiz upon all branches of natural science in America, his influence was exerted directly upon this department in the university on three occasions. In 1867, his counsel was given as to its organization, when his recommendation led to the appointment of Professor Wilder; and again, at the opening of the university, when he was

present and gave an encouraging address; he also remained to deliver a course of twenty lectures on zoology, which, to use the words of an alumnus who heard them, "were more useful to the university than any other one thing."

In 1871, he enlisted the co-operation of Professor Wilder in making a series of preparations of the brains and embryos of domesticated animals for the Museum of Comparative Anatomy in Cambridge, with the privilege of publishing the results of his discoveries. Since that time the professor has made neurology his special study, and his lectures and writings upon the subject have contributed to develop this study without as well as within the university.

A letter of ex-President White upon the work of this department, dated in St. Petersburg, July 29, 1893, may properly be inserted here:

Your proposal to publish a *Festschrift* for Professor Wilder, at the approaching university anniversary seems to me admirable from every point of view. Such a tribute would not only show a spirit most honorable to his old students taking part in it, and, doubtless, most acceptable to him as indicating the opinion of those best able to judge regarding his noble work at Cornell, but it would reveal a beautiful chapter in the records of American science, indeed several chapters, since Professor Wilder has not only done his own immediate work admirably, but has stimulated others to make most excellent contributions in other fields.

My acquaintance with the professor began in the earliest days of the university organization, when having been asked by the trustees to name candidates for the various professorships I visited Professor Agassiz at Cambridge and Nahant and consulted him regarding those to have charge of the various departments in natural science. Among the first whom he named to me was Dr. Wilder, and I remember his taking me into the building where the doctor was at work, and introduced me to him; it was Agassiz's judgment that led me to nominate Dr. Wilder, and everything since has proved that his selection was most fortunate for the university.

He came to us at the very beginning, and has borne the burden and heat of the day ever since; working with a devotion to science, to his students, to the university, and to all truth as it presents itself to him, in a way which has entitled him to the gratitude, love, and respect of us all.

Not least among the services he has rendered has been his promotion of cheerfulness and hope in the early dark and difficult days of the university organization. That is a service which I personally can feel as deeply perhaps as any one, but the services which he has rendered to science by the thoroughness of his researches in the laboratory, and the beauty of the presentations of his conclusions in the lecture room, you and all those acting with you are able to appreciate better than I can, high as my opinion of them is.

There is one point on which Professor Wilder in the early days was able to render a special service outside of his chosen field, and I may be pardoned for referring to it here. While the university was in its earliest beginnings, a sort of nebulous state,

I was greatly impressed by a remark by Herbert Spencer in his book on evolution, as regards the relative values of different kinds of knowledge. He named among the things to be taught to young men, human anatomy and physiology; and his arguments seem to me now to be absolutely conclusive. For apart from the practical part of these studies, they seem to form a most stimulating beginning to study in natural history generally, not perhaps the logical beginning but the best practical beginning, as is shown by the fact that in all ages the great majority of students of note in natural science have been physicians. Under the influence of this impression I asked Professor Wilder to give a course of lectures every year to the freshman class on anatomy and physiology. Various arguments might have been used against this; it would have been said that, later in their course, students would have been better prepared to appreciate the fine points of such lectures, and the example of all the older institutions might have been pointed to in which such lectures, when given at all, were generally given as a hurried course in the senior year. But the idea of making an impression in favor of studies in natural science, and especially in human anatomy and physiology, just when young men were most awake to receive them, carried the day with me and hence my request to Dr. Wilder. He acceded to it at once and for several years, in fact, until the pressure of other duties drew him from this, he continued these lectures, and it turned out that I had builded better than I knew; not only did the lectures produce admirable practical results, not only did they stimulate in many young men and women a love for natural science and give them an idea of the best methods in its pursuit, but they made a most happy literary impression upon the students generally; the professor's wonderful powers of clear presentation in extemporaneous lectures proved to be a wonderful factor in literary as well as scientific culture.

There was another theory of mine proved to be true by the professor; for I had often felt that mere talks about literature, mere writing of essays, the mere study of books of rhetoric, were as nothing in their influence on the plastic minds of students compared with lectures thoroughly good in matter and manner given in their hearing day after day. Naturally I have always felt exceedingly grateful to Professor Wilder for proving that theory true and at the same time rendering a great service to his students and to the university.

On his personal characteristics, which we appreciate so highly, I surely need not dwell; the deep affection in which he is held by all who have known him best is worth more than all words; and I beg to tender to him through you the assurance of my sincere respect and gratitude with the affection of an old colleague for one who bore burdens with him and to whom he is so largely indebted for any success in the work entrusted to him.

An entrance requirement in physiology and hygiene was early included among the elementary subjects for admission to all courses in the university, and the standard has been steadily raised. So far as is known this antedates any similar scientific requirement for admission to any American university.

Although the department possessed the only compound microscope in the university, no advanced work was done with it, or systematic in-

struction offered in its use until 1873. In that year Dr. W. S. Barnard, of the class of 1871, returned from Germany after a course under Gegenbaur, Leuckhart, Haeckel and others. During the two following years he did much original work as a graduate student in histology and in the study of the protozoa. In the fall of 1873 a freshman, Simon H. Gage, succeeded Professor Comstock as helper in the laboratory. His zeal and ability, his prompt mastery of microscopical methods, his patience, and especially his early manifestation of the rare and precious quality which may be designated as morphological insight, caused him to be entrusted more and more with the personal instruction of the laboratory students, whose numbers and requirements were then rapidly increasing. In the year 1878 he was appointed instructor, and abandoned the idea of practicing medicine; he was made assistant professor in 1881 and associate in 1889. It is gratifying and encouraging to state that these promotions were due, not to the discovery of his merits by other institutions, but to the recognition here of his value to Cornell as a man, investigator and teacher. He has, however, declined several independent positions with higher salaries, because he appreciates the earnestness of his students, his opportunities for research and advanced instruction, and the spirit of mutual confidence and helpfulness that characterizes the whole department.

Since 1885-6 the courses in anatomical and microscopical methods, histology and embryology have been substantially conducted by Professor Gage, with the assistance since 1889 of Dr. G. S. Hopkins. No more accurate or complete instruction in microscopical methods and in vertebrate histology is elsewhere afforded. Mr. Fish has made a special study of the histology of the nervous system, so that unusual facilities are now afforded for instruction and advanced work therein. A special course in it is given by him this year for the first time

The very great advantages for the study of zoology in Ithaca were immediately recognized, and from the first, every effort has been made to collect and investigate the local fauna. As the years have passed and the fauna been more carefully studied, the advantages of the situation, with lakes at once isolated and yet with remote connections through the Oswego River, Lake Ontario and the St. Lawrence River with the ocean, has been fully appreciated. Furthermore, in the gigantic experiment due to the glacial epoch, and the restocking of the lakes and streams with aquatic life, there was promise of most interesting and far-reaching conclusions, to be attained by a profound study of the

forms here presented. Believing in this great opportunity the fauna, especially that of the lake (Cayuga), has been the subject of the most extended and enthusiastic study on the part of both students and teachers. As all advanced and most graduating theses are based upon original observations and deductions, the various members of the lake fauna have served for subjects of theses. Many of the theses have been of great excellence, not only serving to initiate their writers into the modes of conducting and carefully reporting the results of investigation, but many of them have brought out almost un hoped for facts and important generalizations. Among the members of the lake fauna the lamprey, the lowest fresh water vertebrate, and the necturus, one of the salamanders with permanent gills, was early recognized as especially desirable for study and with promise of valuable results. The necturus has therefore largely taken the place of the more specialized frog as a representative amphibian and vertebrate. The advantages of the necturus have been clearly pointed out by Professor Wilder, so that now it is a common object of study in many universities, and although it is found in other waters of the country, most of those studied are obtained from Cayuga Lake. The same animal presents unusual advantages for microscopical instruction and research. Its histologic elements or tissues are so coarse that they are easily studied. Indeed its blood corpuscles are so large that they may be seen with the unaided eye. Probably no other animal shows so well the circulation of the blood. The external gills are so vascular, and so easily observed under the microscope that its study has become a part of both general and special students. Probably no other animal has done more to arouse interest in physiology and to cultivate an appreciation of the marvelous and beautiful things in nature, if we only look beyond an exterior sometimes unattractive. The lamprey eel has replaced the ordinary fish as an object of study in the general classes in zoology, and has served also for some extended observations; the investigations have not only added to knowledge concerning the species and the group, but have led to general conclusions of great value concerning the possibilities of evolution.

As an introduction to human, comparative, and veterinary anatomy and physiology, the domestic cat has been employed for dissection, for museum specimens and for experimentation. About 400 of these are now consumed annually.

It is one of the doctrines of the department that the members of the class in zoology shall be able to observe the natural behavior of the objects of their study. Hence, in addition to what may be called the "stock series" of representative forms—cats, frogs, necturi and other salamanders, alligators, turtles, serpents, amias and lampreys—less common animals have been kept alive in cages or aquariums, freely accessible to the students and the public. Among the forms thus available for quiet observation, may be mentioned a pair of deer with their fawn, two bears, several monkeys, raccoons, lynxes and opossums—some of the latter with young in the pouch—an armadillo, porcupines, woodchucks, muskrats, bats, hedgehogs, prairie dogs, eagles, hawks, owls, herons, loons, lizards, Gila monsters, "horned frogs," a megalobatrachus (the great salamander of Japan), cryptobranchus, garpikes, and many kinds of fish from the lake and streams. The general and deep interest aroused by living animals, and the usefulness of their study, lead to the hope that a zoological garden may sometime be established, either by the city or by the university.

For several years after the opening of the university, the animals for demonstration and dissection were obtained as needed, and kept but a short time before they were used. This rather primitive method became impracticable, however, as soon as the number of advanced and laboratory students increased. To avoid the delay occasioned by going out to secure an animal when it was required, and to render the work more prompt and satisfactory, there was prepared what is known in the department as the "frog spring." At a short distance from the university is a series of springs along the margin of Fall creek. One of these was carefully dug out and supplied with a bottom and walls of Portland cement. Into this aquarium the water from a spring flowed, the outlet being diagonally opposite. A partition of wire separated it into two rooms, and a heavy oak cover with locks enclosed it from above, so that the animals in it would not be disturbed by predacious creatures like the mink, or the ordinary biped bent on mischief. In this spring, the winter supply of frogs, a stock of necturi, and other aquatic animals are kept, and specimens are obtained as desired. This spring has proved one of the most truly economical acquisitions of the department.

For storing the barrels of alcohol and other inflammables, and as a home for the cats and other of the higher animals used for dissection and demonstration, a deserted workman's cottage was first utilized, not far

from the laboratory. When this was removed to give place to Lincoln Hall, a special building was put in the forest back of Sibley College. This building served, like the old one, for the live cats and other mammals used for dissection, and for the storage of alcohol, petroleum and rough specimens. In June, 1892, the building with its contents (including the bones of an elephant) were destroyed by fire, and its various uses are now better subserved by separate rooms in the basement of McGraw Hall.

A special fire-proof room has been prepared in the basement laboratory for the incubator used in the courses in histology and embryology. This instrument, which must run night and day, is not therefore a source of danger, for it is so connected with a flue that if the entire contents of the room were to burn up no injury to the building would result.

One of the most vexed questions arising in every newly established laboratory is the disposal of the laboratory waste. In 1893 a "Gregory furnace" was obtained, and the waste is now consumed by fire without offence.

The ideas upon which the vertebrate collections have been formed and arranged, are thus described in an article in Science:

The exhibition cases should contain only specimens which can instruct or interest the visitor. Not only should the facts be displayed, but fundamental principles should be illustrated. There should not only be special series of embryos, brains, hearts, etc., but such preparations should be associated, to a certain extent, with the animals to which they belong. Preparations illustrating important facts should retain so much of the entire animal as may facilitate recognition and association; when this is inconvenient, the preparation may be accompanied by a figure of the animal. When the relative rank of several forms is well determined, the lower or more generalized should be placed below or at the left, and the higher or more specialized above or at the right.

Of natural series, the most conspicuous and complete should be the *vertebrate branch synopsis*: this should embrace, within a space easily covered by the eye, one stuffed example or model of a species representing each vertebrate class, together with four preparations exhibiting the vertebrate type of structure; viz., a transection of the whole body; a hemisection of the whole body; a complete vertebral segment; a hemisected skeleton showing the variation in size of the neural and haemal cavities. So far as possible, these preparations should be made from members of different orders of the class, and be accompanied by outline diagrams and explanations.

Each class, but first and especially the mammalian, should have its own special synoptic series, embracing one or more entire examples of each order, and preparations illustrating the characters of the class.

Among special series other than systematic, are *analogous forms and structures* which are sometimes mistaken for one another, but more readily discriminated when

brought together. Such series are the rostrated animals, spinous forms, and those who have parachutes. *Physiological series* would contain the hibernating animals, those which are blind or nearly so, and such as are provided with scent-glands, tusks, and all poisonous vertebrates.

A *local collection* should embrace all the animals of the vicinity, and will benefit the student, both as an example for him to follow or improve upon, and as exemplifying the laws of geographical distribution and the influence of environment. The local collection need not contain anatomical preparations, but should exhibit both sexes, and all stages of growth of each species,—its mode of life, friends and foes,—so as to interest also the children, farmers, fishermen, hunters, and other residents of the neighborhood.

The sums available from the annual appropriations for the increase of the Museum have been very small. Through the efforts of President White, a single grant made it possible to secure many important specimens from Ward's Natural Science establishment at Rochester, but much is still needed to complete the series.

With the exception of some mounted skins and skeletons, nearly all the specimens exhibited in the Museum have been prepared by members of the staff or their student assistants. Among the latter should be particularly mentioned Theobald Smith, F. L. Kilborne, B. L. Oviatt, E. H. Sargent, J. M. Wilson, Miss O. O. Strong, R. B. Hough and M. J. Roberts. Some of the preparations which they have made are not only instructive but elegant and even unique.

Donations to the Museum have been numerous and often valuable. Besides constant remembrances from former students, there should be mentioned particularly the collection of 300 mounted birds, mostly from North America, presented by the late Mr. Greene Smith, of Peterboro, in 1868, and a series of bows and weapons and implements of Anglo-Saxons, Romans and Britons, presented in 1870 by the late Professor George Rolleston, of Oxford University.

To render the educational value of the Museum as great as possible, it is intended that each specimen should be accompanied by a concise statement of the most important facts respecting it in particular and such specimens in general; and, if it is an anatomical preparation, also a figure or photograph bearing the names of the principal parts, and an enumeration of the points illustrated by it.

It is one of the canons of the department that all of the work done by the student in investigation shall be accurately described; but as verbal descriptions alone are inadequate, careful drawings are required as an essential part of the description. Since 1874 photography has been very largely employed in the exact delineation of complex objects.

It was early seen, however, that in order to render photography applicable to the reproduction of figures of the great variety of objects studied, it would be necessary to devise some means by which the specimens could rest in the position most natural and least liable to injury; sometimes in a liquid to support delicate parts and prevent their collapse. Hence a vertical camera was devised by the associate professor. In photographing with this, the object rests horizontally, and the camera points directly downward. With this camera hundreds of pictures of the most varied objects have been made; many of which have served as the basis for drawings to illustrate special investigations; and some, of entire animals photographed in the water, have served for half tone and photogravure reproduction. Rare animals or specimens are photographed upon their receipt by the department, before dissection, and frequently during various stages of dissection. Fresh fishes and other aquatic animals are photographed under water, either immediately after death or while etherized. In this way the fins and other flexible parts float out in their natural condition and a most truthful picture of the animal results.

Beside the ordinary photographic cameras and objectives, the department possesses a very complete and perfect outfit for photo-micrography. Indeed it may be said that the scientific work of the department and its publication have been greatly advanced and encouraged by the above photographic facilities.¹

Among the special features which have been introduced as aids to study are the card catalogues, containing names and descriptions of the various objects preserved, a book catalogue, the slip system of notes and photographs of objects studied, which are inserted in portfolios or mounted.

Injection designates the method of preparing and preserving animals or their parts, and especially hollow organs, by the injection of the preparation into the arteries or the carotids. The transmission of preservative liquids to the tissues by a constant pressure-apparatus connected with the vessels by which blood reached the parts during life, is really so simple, as well as effectual, that it is hard to account for its comparatively infrequent adoption. Without previous acquaintance with what had been done by others, Dr. Wilder began, with the

¹ For the figures and description of the vertical camera and its application to the reproduction of natural history figures-see Science, vol. III, page 443, and the "Microscope and Microscopical Methods," fifth edition, page 146.

co-operation of Professor S. H. Gage, on October 7, 1883, upon the body of a young chimpanzee, an alinjection of the entire body, which was prolonged for ten days, and was completely successful. In November, 1885, a manatee, 150 ctm. long, was prepared in like manner; all the cats used by the general class in physiology are alinjected and packed away till wanted; still-born children are commonly so preserved, and all anatomical material in medical dissecting rooms may be thus rendered innocuous, free from unpleasant odor and fit for prolonged and thorough examination.

This method of preservation, for the more satisfactory display and study of hollow organs like the heart, is believed to be one of the most valuable methods introduced by the department. By its means, the heart of the sheep, used by the general class in the laboratory work or "practicums," becomes almost as easy of dissection and of comprehension as the elaborate and costly papier maché models. This method of preparing the eyes used for class dissection has also been of the greatest service; for the study of the cavities of the brain, its value cannot be overestimated.

Since 1880 the members of the department have united in an effort to improve the terminology of anatomy in two ways: First, as to the terms of position and direction; to employ such as relate to the organism itself and are applicable to all the vertebrates, *e. g.*, dorsal and ventral for posterior and anterior, or upper and lower. Second, to replace the names consisting of two or more words by names of one word, *e. g.*, corpus callosum by callosum; commissura anterior by precommissura. The objects attained by the change are brevity; capacity for adjective inflection, and substantial uniformity in all languages, since the Latin original can be adopted with unessential changes to modern languages.

What effect the precept and example of this department may have exerted, cannot now be estimated, but progress is making steadily along these lines irrespective of the general adoption of any special set of terms. Much of the success of the instruction has been due to the habit of consistently employing only one series of names in a given lecture, article, or book.

The head of the department is in the habit of urging his students to strive in composition for *clearness, consistency, correctness, conciseness, and completeness*. These he calls his five C's:

In all the courses, general as well as special, in the laboratory work and in publication, weights, lengths and volumes are stated in the metric system, although the common equivalents are sometimes added.

The lectures in physiology have been illustrated by experiments mostly upon the cat and frog. But the charge of cruelty cannot be maintained against the department.

Although our subject is the physiology of *man*, yet—because most of the organs are out of sight and experimentation upon human beings is limited—the bulk of accurate physiological knowledge has been gained from *animals* and must be illustrated therefrom.

All the experiments in this course are (and always have been) performed upon animals just killed or completely anesthetized; the utmost pain inflicted is in killing a frog by “pithing” with a sharp knife, and this is approved as a humane method of slaughtering animals for food. The writer holds that nothing more is warranted in the way of *illustrative* experiment; his proposition that the two kinds of vivisection should be verbally distinguished as *sentisection* and *callisection* (the latter from the Latin *callus*, insensitive) was published in *Nature* at the request of the late Charles Darwin.

No lecture in the department has ever been given without specimens or models, and sometimes as many as forty different specimens are brought from the museum or laboratories to illustrate a single lecture. When practicable they remain for more leisurely examination by the class.

Each class, whether general or special, is invited to regard the lecture room as its “study” for the term, and there is unrestricted access to the specimens, books and diagrams.

The museum now contains more well prepared human cerebrums than any other institution in this country. The objects of the collection are set forth in the following paragraph from an article by Professor Wilder:

THE NEED OF PARTICULAR BRAINS.—From the physiological and psychological standpoint it is clearly desirable to study the cerebrums of persons whose mental or physical powers were marked and well known. The present condition of things is illogical and unprofitable. We scrutinize and record the characters and attainments of public men, clergymen and friends, whose brains are unobtainable. We study the brains of paupers, insane and criminals, whose characters are unknown, or, perhaps, not worth knowing.

Another aspect of the matter is the need of a fissural standard, based upon the careful comparison of large numbers of average, intelligent, educated, and moral individuals, excluding the eminent as well as the immoral, the ignorant and the insane.

It must be borne in mind that the fissural pattern of the average, intelligent, educated, and moral human being is undetermined.

When the university opened and for several years afterward, all of the instruction was given by the head of the department. After a lecture to a large class of freshmen, he gave special instruction in the laboratory, thus passing from the simplest facts in anatomy and physiology to a discussion of the profoundest problems in transcendental anatomy. As there were many things to be done, like arranging diagrams, and putting away specimens, etc., and students with limited means were anxious to do something to aid in their support, there arose the custom of having *student assistants*. The number of students employed to render assistance of various kinds in the anatomical department has been, from first to last, quite large, and many have been enabled to complete their university course by the money thus earned. But while this compensation was important, the inspiration gained by the students from the intimate association into which they were brought with the head and other teachers of the department, was of greater value. This association was at once pleasant and stimulating. No student assistant was ever asked or expected to render any service that the teacher himself was afraid or ashamed to undertake, consequently a dignity was given to the work of the department, often disagreeable in itself, and the assistants only needed to know what was desired in order to accomplish it. The intimate knowledge and manipulative skill gained by this co-operation were regarded by more than one of those assistants as an ample recompense, even if no money had been received. Among those who thus rendered help in the anatomical department, one is now a full professor, one an associate-professor, and two, instructors in the university; one, at the time of his death, was a distinguished professor and orthopedic surgeon; and one holds an important position under the government and is one of the highest authorities in bacteriology and pathology in America; one is director of a government experiment station; one has a responsible position in the United States Geological Survey; one as agent of the State Board of Health is endeavoring to stamp tuberculosis out of the dairy herds of New York; others are physicians and teachers in various parts of the country. They all look back to the experience and inspiration gained in their assistant days as among the most powerful factors of their lives.

Early in the year 1893-4, a series of weekly conferences was begun, in which Professor Gage also participated, at which recent observations or conclusions of the speakers or other neurologists were presented and discussed.

The actual work of the department has always been in advance of the facilities offered. If the only room was a poorly lighted basement or the triangular space under the rising lecture seats, the most advanced work was always in progress, such as gave the students the real and living knowledge that would enable them to do their part in life honorably and to be in the front rank. When apparatus or books were not furnished by the university, the teachers supplied the need at their own expense.

The methods of work, and the subjects for special study in biology have changed greatly since the opening of the university, and an honorable part has been taken by this department in bringing about these changes. As stated above, one of the features of the instruction has been a combination of laboratory practice and lectures for all students doing special work in the department; from the beginning the general courses in physiology and zoology have been abundantly illustrated by lecture room experiments, and the exhibition of specimens as well as by special demonstrations; but so fully was the head of the department convinced of the necessity of personal contact of the student with specimens, that he conceived the plan, and took the bold step of making practical work a constituent part of the general lecture courses, so that, even with classes numbering nearly 200, a third of the time is given to the "practicums." This began in 1880-81 in zoology, and in 1886-87 in physiology. When this was publicly announced at a meeting of the American Society of Naturalists in 1883, it seemed like a hazardous innovation, but time and experience have shown the wisdom of the step, and also that the large majority of general students appreciate real knowledge and are willing to undergo the slight inconvenience of attaining it. For the general classes, the material to be studied—cats, sheep-hearts, brains and eyes, etc.,—are preserved in alcohol and prepared so that the minimum of dissection is required of the student. That minimum, however, is considerable, and its accomplishment in the time available is only possible by the aid of printed directions, and of assistants, mostly advanced students, who stand ready to explain difficult points.

Whenever it is deemed desirable to introduce new subjects into the curriculum, the head of the department, with indefatigable zeal and energy took the work upon his own already overburdened shoulders or encouraged some of his assistants to undertake it. Thus the special lecture and laboratory courses in anatomical methods, microscopy, em-

bryology, general histology and the special histology of the nervous system have arisen. The equipment of those courses was at first very inadequate, but earnestness and enthusiasm, while they could not take the place of proper appliances, still made the courses eminently successful and inspiring both to students and teachers. Every step in advance so thoroughly proved its wisdom that material equipment was soon provided, until now it is so complete for the above courses that no student, graduate or undergraduate, is hampered for the want of opportunity, and his attainments are limited only by his own ability.

In the work of the department, as to both research and instruction, while accuracy of observation, description and delineation have been insisted upon, the mere accumulation, publication and communication of isolated facts has never been sought; the effort has been rather to co-ordinate and correlate the facts and to determine their bearing upon general or special questions in morphology, osteology or classification.

Several hundred graduates of this and other universities have worked in the laboratories of this department.

The head of the department has published numerous papers in scientific periodicals; eight articles or parts as collaborator in Foster's Encyclopedic Medical Dictionary, Buck's Reference Handbook of the Medical Sciences; also Anatomical Technology, as senior author with Professor Gage; What Young People Should Know; Health Notes for Students; Emergencies: How to Meet Them; and Physiology and Practicums. Besides the publications recorded above, Professor Wilder has written many articles on natural history subjects for Harper's Magazine, Atlantic Monthly, Galaxy; Our Young Folks, The New York Tribune, etc. He has also written critical reviews of many scientific works for The Nation and for scientific periodicals.

The results of the scientific activity of Associate Professor Gage, B. S. (Cornell, 1877) are embodied in about fifty papers published in scientific journals and in the proceedings of learned societies; eight articles or parts contributed as collaborator in Foster's Encyclopedic Medical Dictionary, Buck's Reference Handbook of the Medical Sciences, Johnson's Cyclopedic and the Wilder Quarter-Century Book; and in three books, The Anatomical Technology, as junior author with Professor Wilder, Vertebrate Histology, and The Microscope and Microscopical Methods. The first book has reached a third edition, the second a second and the third a fifth edition.

The instructor in anatomy, microscopy and embryology, Dr. G. S. Hopkins, Cornell B. S., 1889 D. Sc. 1893, has published four scientific papers.

The instructor in physiology, vertebrate zoology and neurology, P. A. Fish, Cornell B. S. 1890, D. Sc. 1894, has published five scientific papers and contributed an article on histological formulæ to the supplemental volume of Buck's Reference Hand-book of the Medical Sciences.

The publications of the members of the departmental staff embody the results of original investigation in zoology, physiology and histology, or describe new methods devised in the laboratory. Many of these methods have found wide application elsewhere.

THE DEPARTMENT OF ENTOMOLOGY.

Although it was not till the fifteenth year of the active work of the university (the year 1882-83) that a full professorship was assigned to this department, the establishment of a department of entomology was part of the original plan of organization of the university. In the first general announcement of the university there is given a list of seventeen professors that had been elected, and the titles of nine others that were to be elected at an early date. In the latter list the title Professor of Economic Entomology and Lecturer on Insects Injurious to Vegetation appeared.

This long period between the opening of the university and the establishment of a full professorship of entomology was not, however, a period of inactivity in entomological work. A limited amount of instruction in this subject was given each year from the first, and the starting of an entomological collection was begun. Dr. B. G. Wilder, the professor of comparative anatomy and natural history, had given considerable attention to the study of insects, and had made what was considered at that time a large collection. He was able, therefore, to give in his course on zoology a fuller treatment of insects than was usual in courses of this kind. The gift of his collection of insects constituted the beginning of an entomological museum. The increase of this collection by additions made by students began at once. The most important of these additions during the first two years was a collection illustrating the transformations of the larger moths, which was made by Mr. W. D. Scott, who was then a special student in zoology.

At the beginning of the third year of the university, Mr. J. H. Comstock, then a freshman in the course in natural history, was appointed laboratory assistant to Professor Wilder. The very first task that was assigned to the young assistant was the arrangement in systematic order of the collection of insects and other invertebrates that had accumulated during the preceding two years on the shelves of the laboratory. Very soon after this the entire charge of this part of the collection was placed in his hands by Dr. Wilder. Thus the growth of his personal interest in this part of the work of the university began, a part, the development of which has been associated with his life.

Mr. Comstock has been so intimately associated with the entomological work of the university that the following bit of personal history is not out of place in the history of the department: While preparing for college, Mr. Comstock became greatly interested in the study of insects, and determined that he would, if possible, devote his life to this study. The statement in the first general announcement of the university that a professor on entomology was soon to be elected, led him to come to Cornell, in order that he might study with this professor. Thus the opportunity to follow his chosen specialty came to him in due time in a very unexpected way. It came much earlier than would have otherwise been possible, but for the policy of the senior professor of zoology of encouraging his assistants, and stimulating their development, by placing large responsibilities upon them.

During the fourth year of the university (1872-73) thirteen students in the courses in agriculture and natural history petitioned the faculty of the university to allow Mr. Comstock to give a course of lectures on insects injurious to vegetation. This petition, having the approval of Professor Wilder, was granted, and a course of lectures extending through the spring term of that year was delivered. This was the first course devoted entirely to entomology that was given in this university.

At the close of this year an arrangement was made by which Mr. Comstock spent the summer in study with Doctor Hagen at the Museum of Comparative Zoology of Harvard College. This short period of study had an important influence in the development of the department of entomology, which was soon afterward established at Cornell. Not only did Doctor Hagen give daily lectures to his single student, but the great entomological collections of that museum were thrown open to him for unrestricted use. In this way he was able to gain a

knowledge of museum methods, and of systematic entomology, that was of great importance to his future work. The undetermined species in the Cornell collection at this time were taken to Cambridge and classified by comparison with the collections there, and in the museum of the Boston Society of Natural History.

In the fall term of the following year (October, 1872,) a course of twelve lectures on economic entomology was given by Mr. C. V. Riley, then State Entomologist of Missouri; and in the spring term of the same college year (May 2, 1873,) provision was made for continuous instruction in this subject, by the appointment of Mr. Comstock as instructor in entomology. A separate entomological laboratory was at once established in one of the upper rooms of the tower of McGraw Hall, the room adjoining the upper gallery of the museum; and thus a modest beginning of a distinct department of entomology was made.

Within a month after the establishment of the department, it received from Mr. H. H. Smith the gift of his collection of insects, a collection which represented about two years of field work on the part of this unrivalled collector. The specimens were mostly unclassified. But they were immediately placed in the hands of specialists for determination, and soon became available for the use of the department. The collection was especially rich in hymenoptera and diptera; and as the former were determined by Mr. E. Cresson, and the latter by Baron Osten-Sacken, they became exceedingly valuable.

The growth of the department for a considerable period was necessarily slow. The instructor, being still an undergraduate student, could give only a part of his time to it, and the funds at the disposal of the department did not admit of the purchase of any specimens, and of but few books. But so hearty was the sympathy and encouragement extended to the young instructor by President White, Professor Wilder, and other members of the faculty, that the lack of time, of specimens, and of books, was hardly considered. Another source of great encouragement in those days of small beginnings was the attitude of the students. If any of them appreciated the crudeness of the facilities offered, they did not express it by word or look, but each did his part to make the work as successful as possible.

In the summer of 1875 plans were made for an extension of the department of entomology by transferring to it the work in invertebrate zoology. In anticipation of this change, a leave of absence was granted to instructor Comstock, in order that he might spend a part of the fol-

lowing year in study with Professor Verill at Yale College. This he did, returning in time to give his lectures on entomology in the spring term.

The proposed extension of the department was made in the fall of 1876 by the promotion of Instructor Comstock to the rank of assistant professor, with the title assistant professor of entomology and invertebrate zoology.

The wording of this title indicates the direction in which it was determined that the growth of the department should proceed. Although instruction was to be offered in the general subject of invertebrate zoology, the department was to remain essentially entomological. This was in accordance with the plan of organization of the university, by which subjects relating to agriculture were to receive especial attention.

In carrying out this plan, however, the constant aim of the instructor has been to give the students thorough training in the science of entomology. It has seemed wiser to enable the students to lay a broad foundation for their entomological studies by giving them a thorough knowledge of the structure and development of insects injurious to agriculture. At the same time, great pains have been taken to present in lectures and field work the applications of the science. This has been largely accomplished by selecting, for purposes of illustration, those species that are of economic importance.

In addition to the desire to strengthen the work of the College of Agriculture there has been another important factor in determining the direction of the growth of the department of entomology. Owing to the difficulty of studying marine animals at any place remote from a sea coast, and to the exceptionally good facilities for the study of insects at this university, it has been felt that the best interests of science would be subserved by concentrating our advanced work on insects, and frankly advising those students that wish to make a special study of marine forms to go to some university situated near the sea. It has seemed better to lead in one specialty than to hold a mediocre place in the whole field. An opportunity is offered the student to lay a broad foundation for zoological studies by lectures covering in a general way the field of invertebrate zoology, and by a study in the laboratory of a wide series of typical forms, illustrating the more important groups of invertebrates. These two courses, taken in connection with similar courses offered by the Department of Physiology and Vertebrate Zoology afford the instruction needed in zoology by students in the