HISTORY OF DEPT.

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which have hitherto been offered to the student. This has been done by establishing an alternative course in Physics, to be known as Course VIII, B, which will differ from the present Course VIII chiefly in the continued study of electricity instead of the pursuit of other branches of Physics, and in the introduction of a considerable amount of practice in the Laboratory of Mechanical Engineering and the Workshops, in place of Chemical Analysis. An endeavor will be made to give to students pursuing this course a knowledge of the theory of Electricity sufficiently extensive to prepare them for all ordinary electrical work and which shall also serve as a foundation for more advanced study. They will receive instruction in the Physical Laboratory in the various methods of electrical testing. Special in-

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struction regarding Land and Submarine Telegraphy, the Telephone, Electric Lighting, and the electrical Transmission of Power will be given, and the study of Acoustics will also be required in view of the art of Telephony.

"The nature of the course is evidently such that facility in the acquisition of both mathematics and physics is essential to pursuing it successfully."

We have in this, a concise statement of the chief characteristics of our Course in Electrical Engineering, as it exists today, and of all other successful courses in the subject as they have been established elsewhere. This circular announced the establishment of the first course in Electrical Engineering in the country, and marked a distinct step forward in the matter of technical education.

Work in the new course was begun in the fall of 1882, there being six regular students. Only students who were to take the full course, beginning with the second year, were accepted. The specialized work of this first class was of three years' duration as it is at present, and the first class was thus graduated in 1885.

In 1882 the whole Institute, with the exception of the shops, was accommodated in the Rogers Building. The dynamo used by the Electrical Engineering division was a two-light Brush machine; it was set up in Professor Richards' domain so that it could be belted to his steam engine. The other electrical apparatus was in the space now occupied by the library. In 1883 the Walker building was completed, and in the spring of 1884 the Physical Department was transferred to new quarters. The power necessary for the operation of the various machines was transmitted by a line shaft which ran through a tunnel between the Rogers and Walker buildings, and was furnished by a Porter Allen engine in the Laboratory of Mechanical Engineering then located in the basement of Rogers. In 1887 Mr. Edison presented to the Institute one of his commercial dynamo machines. Both it and the Brush machine are still in use.

All the working of electrical measurement and testing was concentrated in Room 10, which was then considerably smaller than at present, part of the space being occupied by apparatus cases and a small recitation room.

Concerning the subject matter of the instruction in those early years I shall speak in the light of my personal experience at the Institute, which began in 1885. Work of the first year was in general of the same preparatory character as at present, though the mathematical requirements were less advanced than at present. In the second year the strong course was in Physics, and in view of recent changes in Course VI, it is interesting to observe that instruction in the important subject of mechanics was given not only in the lecture room, but in supplementary class room exercises, when there was time for the solution of problems under the eye of the instructor.

The detailed study of electricity began as at present in the third year. Professor Cross conducted the class which numbered about fifteen men. The text-book used was Fleeming Jenkin's Electricity and Magnetism, a book remarkable in its time for the manner in which it dealt with the subject, and its insistence on exact measurement. It was written by one with a rare faculty for correlating theory and practice, for Jenkin was an engineer of distinction and a student of science as well. His point of view is well illustrated by the following extracts from his preface: "In England at the present time it may be said that there are two sciences of Electricity—one that is taught in ordinary text-books—the other, a sort of floating science known more or less perfectly to practical electricians, and expressed in a fragmentary manner in papers by Faraday, Thomson, Maxwell, Joule, Siemens, Matthiesen, Clark, Varley, Culley and others. The science of the schools is so dissimilar from that of the practical electrician that it has been quite impossible to give students any sufficient text-book. A student might have mastered Delarive's large and valuable treatise and yet feel as if in an unknown country and listening to an unknown tongue in a company of practical men. It is not a little curious that the science known to the practical men was, so to speak, far more scientific than the science of the text-books."

It was such a book that Professor Cross took for his text, filling in the gaps, when necessary, and bringing the subject matter fully up to date, and I doubt if ever a class was subjected to closer questioning on what they were supposed to know. This course was followed by one on Direct Current Generators and Motors. Professor Cross also conducted this, using as a text-book Silvanus P. Thompson's Dynamo Electric Machines. The purely theoretical work, given by Mr. Clifford, was along the lines of Electrostatics and Potential, for the many ramifications of alternating current theory simply did not exist. The laboratory instruction was almost wholly in the lighter electrical measurements and was in charge of Professor Holman. This arrangement continued until Professor Holman's retirement on account of ill health in 1896, at which time the work in Electrical Measurements was undertaken by the writer. Gradually the dynamo laboratory was developed, Professor Puffer devoting himself to it and the photometric work.

To Professor Holman the Institute owes a lasting debt of gratitude for his efforts which resulted in the establishment of our high standards of requirement in the experimental work of electrical measurements and dynamo testing. That there might not be a great waste of time through misdirected effort in this and other experimental work, he devised a course in Precision of Measurements and introduced it into the curriculum. Professor Holman gave himself without stint to the improvement of the methods and the equipment of the laboratories. Much of what he did was accomplished under circumstances which would have daunted a less courageous man. For years his health was not robust, and he was a great sufferer, but he never allowed this to warp his judgment or render crabbed a nature which was not without fire.

In 1898 a large room in the basement of Walker Building was set apart as a dynamo laboratory. It was equipped with a 75 h.p. Westinghouse engine, belted to a jack shaft from which the various machines were driven. In 1893 these were as follows: a 150 light Edison dynamo; a 200 light Thomson-Houston machine; a 60 light Weston machine; a 500 light Thomson-Houston alternating machine; a 300 ampere U. S. machine of low voltage, and a 3 light Brush dynamo.

Very early it became apparent that in every class there were a few men of superior capacity who would profit by more advanced instruction than that given in the regular order of things, and accordingly optional advanced courses were given which were open to those qualified. It was in this manner that the course in alternating currents was begun in 1891.

For a number of years the Institute catalogue contained a general statement concerning graduate courses leading to the Master's degree, and in 1901 the Department of Electrical Engineering definitely offered such a course and in the catalogue of that year may be found the scheme of studies. In 1903 it became possible to obtain, after a minimum of two years' graduate work, done in residence, the degree of Doctor of Engineering.

A distinct course in the theory of alternating currents was given for the first time in 1891 by Professor Clifford to a few men who formed a special class; from that time to the present, this subject has been of increasing importance in our curriculum.

The next considerable advance in equipment was in 1896 when an experimental plant was installed solely for use in regular laboratory instruction in connection with the course in dynamo testing and dynamo electric measurements. It consisted of two similar 25 k. w. machines, belt driven from a Westinghouse compound engine, the latter being fitted with a condenser and all necessary auxiliary apparatus. This set is now installed in the Lowell Building.

Changes in the course of study were made as the science and art of the electrical engineer advanced, and the course at the Institute always kept its position as a leader in this class of education.

In 1902 it was decided to remove from the Department of Physics that portion of the work which was of a distinctly technical character, and the separate Department of Electrical Engineering was created. Dr. Louis Duncan, sometime Professor of Electrical Engineering at Johns Hopkins University, and later a practising engineer in New York, was placed in charge. At that time the Loweli Building was constructed and sufficient space allotted to the various parts of the work so that they might properly develop with the rapid progress of Engineering. In 1904, Professor H. E. Clifford was made acting head of the department. His administration was characterized by a close study of the needs of the profession and an adaptation of the instruction to meeting these needs adequately. It was also characterized by a careful study of the requirements of individual students and the establishment of post graduate work of a most advanced character. The watchword of Professor Clifford's administration was "Develop the power of analysis," and to the young graduate himself was left the acquirement of the various short cuts and tricks of trade which all engineers must have at their command.

Professor Clifford never lost sight of the fact that to get the best results, "team work" on the part of the instructing staff was absolutely necessary, and he spared no pains in bringing this about, one of the most effective agencies being the departmental conferences where all questions of interest were frankly discussed.

In 1906 Professor D. C. Jackson, Professor of Electrical Engineering, at the University of Wisconsin, was made head of the department. Professor Jackson, after graduate work in electrical engineering at Cornell University, entered the employ of the Sprague Electric Railroad and Motor Company, thus gaining his electrical engineering experience during the early and trying years of electrical development. In 1891 he was called to the University of Wisconsin and served there continuously until his coming to the Institute, at the same time being engaged, together with his brother, Wm. B. Jackson, in conducting an engineering office. The questions of finance connected with electrical undertakings of large magnitude possessed a great attraction for him, and gradually his interest shifted from the purely constructional engineering side of the work to questions of engineering economies. So that he now has to do with such large questions as, for instance, the proper determination of telephone rates in the State of Massachusetts, this problem necessitating an immense amount of work. He has also investigated questions connected with the telephone franchise in the city of Chicago, and done many other pieces of work of like magnitude. The reaction of these activities on his instruction work is seen in his course on Public Service Corporations, given to the post-graduate students. In addition, Professor Jackson has done much work of an expert nature in connection with patent cases. The principal changes introduced into the course of study since Professor Jackson took charge of the Department are the beginning of Applied Mechanics in the second instead of the third year, and the extension of the work in Hydraulics.

With Professor Jackson came Professor G. C. Shaad, also of the University of Wisconsin, who took charge of the work in electrical installations and the allied excursions. In the spring of 1909 Professor Shaad was called to the chair of Electrical Engineering in the University of Kansas. There he became head of the Department. At the same time Professor Clifford tendered his resignation, after twenty-three years of service to the Institute, to become Professor of Electrical Engineering at Harvard University. These changes rendered it necessary to bring to the department two new men. To fill these positions Dr. Harold Pender came from New York City, where he had been engaged in electrical engineering work of a general character, and Professor W. E. Wickenden from the University of Wisconsin, where he had been teaching subjects allied to those given by Professor Shaad, whose place he took.

LETTER FROM GRADUATE

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made so much more real by the injection of a little human interest. Many of the professional subjects, such as Thermodynamics and Applied Mechanics, suffered severely from the abstract manner in which they were presented. Whether it was because I was better prepared to digest the electrical subjects and to add my own "human interest," or not, I do not know, but for some reason it seems to me that the mechanical engineering subjects were much more lacking in this respect than the electrical ones.

One of the greatest disappointments of my entire four years was the course in the Mechanical Engineering Laboratories. As a Freshman and a Sophomore I often wandered around among the engines, pumps, etc., and looked forward longingly to the day when I would be privileged to handle them and know all about them. But, alas! that time never came, for as a Junior and a Senior, I found myself somewhat in the same position as the little girl in the nursery rhyme:—

"Mother, may I go out to swim?"
"Yes, my darling daughter;
Hang your clothes on a hickory limb,
And don't go near the water."

For the machines were always thoughtfully started and adjusted by the instructors before the students arrived and all the latter had to do was to take a few indicator cards, or read a speed counter for a while, and then make a lot of calculations. One shining exception, however, was the little Harris-Corliss engine on which we were allowed to set the valves and to actually open the throttle ourselves and make the wheels go around. I believe that the two hours which I spent on this test were of more real benefit to me than any ten other assignments in the course.

This matter of actually handling the machinery, themselves, in a laboratory of this sort, is of vital importance to the students. It may seem a small thing to open the throttle and start a

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E. E. SOCIETY

The Electrical Engineering Society ranks as one of the foremost professional societies at the Institute. The object of the Society is twofold, first, to bring together socially the men in Course VI, and, second, to give the members some idea of the practical application of the studies they are pursuing. To accomplish these objects, monthly meetings are held, at which the Society is addressed by men prominent in electrical engineering, excursions are made to plants of interest around Boston, and an annual dinner is given during the latter part of the year.