FUTURE OF COURSE VI

(Continued from page 49.)

but it is necessary for the student to put his mind to the test of his own education and not rely solely on professors or curriculum if he expects to go beyond the timber line of ordinary achievement. With this clearly in mind, I am will ing to say that I do not believe that there is any place in the country where the study of electrical engineering can be caried on so favorably as at Technology. This applies equally to undergraduate study and to students following graduate study and research. The latter should steadily become more important for the highest training of the ablest young men entering the profession of electrical engineering, and the opportunities of pursuing them should be embraced by a steadily increasing number of students who desire to cultivate the keenest power of analysis and reasoning which arc pre-eminently useful to the electrical engineer.

Of itself, much inspiration may arise from studying electrical engineering in a pioneer institution in the field, which

PROFESSOR DUGALD C. JACKSON.

has contributed a large body of young men already becoming and become eminent in engineering and industrial life. The electrical engineering course at Technology in this respect holds a remarkable place. Its early establishment and its fine body of graduates make its influence felt through all the ramifications of electrical industries.

The curriculum of the Course is planned to lay broad and deep in its students the foundations for sucessfully following the duties of electrical engineers. Students who come to the Course from high schools and preparatory schools are expected to obtain at the Institute certain definite training; including the additional training in the use of the English language which is requisite to clear thinking, clear writing and persuasive speech, and also some foreign language for the purpose of adding strength to the language acquirements; the collateral art of expression by drawing, which goes hand in hand with language as an art belonging to successful engineers; mathematical training, to establish accurate reasoning powers and also give a useful and powerful tool in the solution of many problems of electrical engineering; the science of chemistry and the science of physics, to give an acquaintance witn the known facts of nature with which the engineer must work, and the relations of those facts with each other; applied mechanics, which is the philosophy of matter, force and energy and is the backbone of an electrical engineers' power; and much in regard to the many useful applications of nature's forces. Students coming from the college courses pursue such parts of the foregoing subjects as have not been suitably covered in their previous courses.

No man who becomes an electrical engineer can confine his study to electricity and magnetism, but, having mastered the fundamental principles, he must also learn in regard to the characteristics and uses of constructive materials, their correct application to the building of actual structures; the meaning of kinematics to the engineer, and the processes of designing, constructing and using real machinery; something of the special principles of thermodynamics and hydraulics and the ways in which those principles are utilized in the designing, constructing and operating of prime movers; and also something must be learned of the efficiencies of numerous industrial processes, for applied electricity has invaded nearly all fields of industry. Besides these numerous branches, our electrical engineering students are expected to learn to reason clearly and rationally in regard to the specific principles relating to applied electricity and magnetism, including all their diverse factors, and the ways in which these principles enter into everyday practice.

This is a formidable array of important study, but it may be successfully accomplished by an alert minded student in the allotted four undergraduate years and still leave the time requisite to pursue those general or humanistic studies needed to stir ambitions and give a familiarity with tne development and manners of mankind. But it is preferable for the ablest men to add to the undergraduate years one or two years of graduate study which are very effective in enlarging and cultivating the scope of the student's vision. Any young man who successfully follows this Course ought to develop those fine but rare qualities of mind called initiative, originality, self-reliance, observation, tact, and reliability. Having these added to knowledge and power in the use of knowledge, he should find electrical engineering a pursuit of pervading fascination.

There are many great places in the industrial world within reach of well-trained and able engineers, and a full proportion belong to electrical engineering. Indeed, the well-trained, able man can usually determine his own place as an electrical engineer, provided he has industry. perseverance, and mental courage to first prove his worth by work. Electrical engineering is an exacting profession in which there is not a great demand for mediocrity, but any really able, ambitious, well-trained young man whose tastes lead him to try electrical engineering will find his services in gratifying demand after he has made sufficient start to prove his industry and ability.

SUBSIDIARY OPPORTUNITIES FOR STUDENTS

BY MR. RALPH G. HUDSON.

The object of this article is to acquaint prospective students in the course of Electrical Engineering with certain opportunities possessed by such a course at the Institute, which are not included in the prescribed curriculum of the department.

Students entering the third year should join the Electrical Engineering Society. The dues are nominal ones. and there are at least three distinct advantages to be obtained by such membership. At the monthly meetings of that Society, the members not only have the opportunity to hear and meet successful engineers who make addresses at these meetings, but the assemblage itself is the only one in which each student may meet all of his classmates to discuss informally the various problems of mutual interest. It is a Society designed to promote a social discussion of business problems. The Society furthermore holds several interesting excursions each year. These trips have included visits to the works of the General Electric Company at Lynn, and the Fore River Ship Building Company at Quincy, as well as to the various power-stations of the Boston Elevated Railway Company and the Edison Company. The insight gained in these trips of the practical adaptation of the theory studied at the Institute is extremely valuable.

Third-year students should also become Student Members of the American Institute of Electrical Engineers. Such membership at \$3.00 per year for three years entitles the student to the Proceedings of the Institute and also gives him the privilege of attending the meetings of the Boston Section. The papers given at the monthly meetings of the local section and the discussion following these will prove of great value in developing the student mind to the realization of the breadth of the electrical engineer's efforts and will keep the student informed as to the trend of engineering developments.

All students should make it a point to attend the lectures of the Society of Arts as far as is possible, and especially those of electrical character.

Not too much can be said of the opportunities offered by the extensive libraries of the Institute. The student should make it a regular habit to look over the contents of the Electrical Engineering Library as well as those of the Physical and Mechanical Engineering Libraries. A general knowledge of the books available in these libraries will prove of great value at various times when the student is in need of explanation upon any suoject. In addition to this, the student should glance over the various magazines on file in these libraries. Very often, the student's conception of certain subjects will be strengthened or made clear by articles appearing from time to time in these magazines.

It must also be borne in mind by all students that the course, although very complete in its laboratory instruction, offers more theoretical instruction than practical, and it is therefore advisable that all students spend a part at least of their summer vacations in practical work.

The attention of the students is called to the fact that in the senior year, an inspection trip is made to the General Electric Company's works at Schenectady, and to the various plants at Niagara Falls. This trip sometimes includes a side-trip to the sub-stations at Buffalo, and on the return to the large power-plants in New York City.

As previously stated, this article is written to prepare prospective students in the side issues and the effort is made to awaken all participating in a course in Electrical Engineering to the various subsidiary opportunities possessed by such a course at the Institute.

RELATION TO OTHER ENGINEERING COURSES

BY PROF. HARRISON W. SMITH.

The extensive application of electricity in many branches of industry is a matter of common observation and articles are constantly published in the technical magazines dealing with special features of the subject. A conspicuous example is to be seen in the design of a modern machine shop where individual motors are employed to drive the larger machine tools while the smaller tools are arranged in groups and driven by a single motor. In this manner the capacity of the tools for rapid working is increased and at the same time power is saved by the elimination of long lines of moving shafts and belts.

Another example of the application of electric power is in mining operations where electric locomotives are used to haul cars, and motors are employed to drive ventilating fans in positions too remote to admit of the use of any other motive power. Again, some mines may be worked by electricity obtained from distant water power under conditions where the cost of fuel and the grade of ore would otherwise prohibit profitable operation.

One of the most striking developments is in electro-chemistry where cheap power has aided the growth of new and valuable industries.

It is unnecessary to cite numerous examples to indicate that a knowledge of electrical phenomena is essential to the engineer in many different branches of engineering, but it is important to consider the kind of knowledge that will be most useful to him. Thus when the non-electrical engineer is called upon to consider a problem dealing with an electrical installation, the factors upon which he must base his solution are, in the first place, the performance, that is the degree of satisfaction with which the electrical apparatus will meet his requirements, and, in the second place, the cost. With regard to the latter the same general principles hold that apply to any engineering proposition and the detailed information necessary in any problem must be obtained to suit the particular conditions. Naturally a proper treatment of the question of cost will involve a knowledge of the performance of the machine which thus becomes of special importance to the non-electrical engineer, and is the chief object to be kept in mind in arranging a course for the non-electrical engineering student.

Such a course must contain a certain amount of specific information relating to the operation of different types of motors, the methods of controlling speed, the operation of generators and the like. More specialized information would in

(Continued on page 53.)

ELECTRICAL LABORATORIES

BY PROF. RALPH R. LAWRENCE.

It is impossible to make engineers in a technical school or college. All that can be hoped to be accomplished is to ground students in the fundamental principles underlying their chosen branch of engineering, to teach them to think clearly and logically and to have the proper initiative in handling new problems. The laboratory is particularly valuable in giving men this training, but in order to produce the best results, it must be conducted in such a way as to leave the students as free as possible in planning their work. Each experiment should call for a definite result, but the method by which this result is to be obtained should be left for the student to plan.

Laboratory experiments which are laid out to resemble more or less closely commercial tests, too often teach little more than dexterity in reading instruments, especially when they are conducted with more or less detailed notes or directions. Commercial tests can seldom be duplicated in the laboratory, as they not only require larger units than can economically be used, but also necessitate more time than is usually available. Moreover, the actual electrical connections can seldom be made by the students, and large apparatus would necessitate the presence of an assistant under whose direction the experiment would actually be performed.

Laboratory work to be most effective must supplement the lecture and class room, and should be made to bring out the theoretical points there discussed. The closest possible relation should exist between the lecture room and laboratory.

This close relation has always existed in the Electrical Engineering Department, especially during the senior year. Each laboratory experiment is planned to bring out the characteristics of the particular type of apparatus to be used. All connections are left for the students to make, and the entire conduct of the experiment rests with them, the work being conducted according to directions they have themselves planned and written before coming into the laboratory.

The actual experiment is performed by the students working in pairs.

The present method of conducting the work in the Electrical Engineering Laboratory, for Courses VI, XIIIa, and XIV is the development of the system suggested by Professor Clifford, about eight years ago. Under this system each student, before coming into the laboratory, is obliged to submit a preliminary report which must be approved before any laboratory work is done. No notes are given tne men, all they receive is a brief statement of the results required in each experiment and the size and rating of the apparatus upon which it is to be performed.

Before each laboratory exercise, the men meet in one of the smaller recitation rooms to write up their preliminary reports, and receive their assignment for the following laboratory exercise from the assistant who is present to give such suggestions as may be needed by the students in writing up their reports. Lecture notes or text-books, except those dealing with laboratory instruction, are permitted. During the first fifteen minutes the students may go into the laboratory to inspect the apparatus to which they have been assigned.

The preliminary reports take the place of the printed notes used in connection with most laboratories. In these preliminary reports tne men must outline the experiment, give diagrams of connections, and state what measurements must be made. The number and sizes of all instruments required must also be estimated. These preliminary reports are read critically and returned for correction several days before the laboratory exercise. Having made the corrections, the students take their reports to an instructor for final approval.

When the students enter the laboratory, one of each pair who are to work together, takes his approved instrument list to the instrument room and receives the required instruments. The apparatus is then connected up and the experiment performed with little or no help.

The data obtained is worked up independently by each man, and submitted in a final report. This final report, in addition to the results, must contain a brief discussion of points which have been brought out by the experiment.