THE DEPARTMENT OF ELECTRICAL ENGINEERING

The following has been written by Professor D. G. Tucker:

The Department of Electrical Engineering is in process of moving into its new building, and this seems therefore an appropriate time at which to review its activities. It has occupied its old accommodation ever since the first Professor of Electrical Engineering was appointed in 1905. During this time the subject has developed very greatly.

Although electrical communication engineering is as old as electrical machinery, yet at the turn of the century the commercial importance of the latter was by far the greater; and this seems to have been reflected in the large proportion of the Department's syllabus which has hitherto been devoted to what are usually termed the heavy-current aspects of electrical engineering. Even today the emphasis of the courses is markedly in this direction. This contrasts sharply with the students' choice of subsequent occupation, which is preponderantly in favour of the light-current side of the industry. Developments in this latter field, e.g. in radio and line communications, have been very rapid since the First World War as the result of the introduction of the thermionic valve. More recently the techniques of communications equipment (loosely termed electronics) have been applied to a variety of military and industrial requirements, such as instrumentation and control of equipment and processes. Electronic computers are already beginning to play a major part in industrial operations and management, and the word "automation," which has recently become current, conjures up a prospect of even more far-reaching applications of light-current techniques. All this development is the result of research in light-current electrical engineering and creates an enormous demand for more. It is not surprising that the glamour of it attracts nearly all the Department's students from the time they apply for admission to the University. By contrast, the development of the heavy-current side of electrical engineering has reached a more nearly steady state; its industrial importance is as great as ever, and further advances will be made, but in terms of new discovery its prospects are not so exciting as those of light-current engineering. Between these two branches the Department has to maintain a balance of interest; studies of automatic control systems afford a valuable bridge between them.

Until 1953 the degree course was the same for all students. Since then a certain amount of choice of special subject has been allowed in the final year, and, in the common part of the course, some increase is being made in the amount of time devoted to light-current work, in order to give equal weight to the two branches. At the same time students are being introduced to electrical engineering in their first year in the University (instead of as formerly in their second year), while they are still engaged on their basic studies of physics and mathematics. It must be remembered that a great deal of work in all years is fundamental to both heavy-current and light-current engineering. The Department thus offers thorough and up-to-date training in basic principles and their application to both branches, and it is hoped that the students, by following the bent of their own interests and considering their prospects of employment, will distribute themselves appropriately in their choice of optional subjects.

The number of students in the Department has greatly increased: the annual intake is now fifty. The opportunities for their employment in industry are more numerous than ever before, and also more diverse, making varied demands on their scientific, technical and personal capacities. It is more obvious than ever that a university course cannot and should not attempt to equip them fully for immediate industrial effectiveness. Its function is to lay sound foundations and to encourage the habit of enquiry, the use of judgment and the application of knowledge to real problems. The foundations must include physics and mathematics, and some of the more general principles of engineering, with emphasis of course on electrical engineering. An important ingredient is the idea of engineering design as a creative intellectual activity; this cannot be taught in formal courses, but in the Electrical Engineering Department is obtained to some extent through work on individual projects in the final year. With the increased physical space available in the new building and with the increased space in the final-year syllabus soon to be obtained as a result of bringing a number of subjects forward to earlier years of the course, these projects will in future be a major part of the final year's work and will form an important part of the honours assessment of each individual. In a further effort to lay suitable foundations, electrical engineering students now attend, in addition to some informal discussion periods, a course in the historical, economic, social and industrial background of their subject. This amounts to forty-eight hours of lectures, and the subject is included in the degree examination. Finally, all students are required to spend a minimum of six weeks in industry during each Long Vacation.

A proportion of the students graduating in electrical engineering take graduate apprenticeships in industry; while this is more or less universal for those choosing heavy-current work, it is optional for those choosing

light-current engineering. There is a lot to be said for encouraging young engineers to learn to take responsibility as early as possible, and as good practical training may often be obtained from taking a responsible appointment as from taking an apprenticeship. In many cases, when a man is thinking of taking up research or development work, a year or two's research in the University may be of advantage, and the Department's research programme is designed to be suitable for the training in research of ten or a dozen graduate students. Although there is much to be said for trying to obtain research students who have had experience in industry, this is quite impracticable so long as the amount of a research grant remains less than half of what a new graduate earns in industry.

The research programme of the Department has been developed on a basis which will provide suitable major research projects for members of the staff and for Ph.D. students, together with smaller research and development projects for M.Sc. students and small individual design and development projects for final-year undergraduates. It is also a feature of the programme that it covers as many aspects of electrical engineering as possible. Although no attempt is made to direct individual workers into team activities, nevertheless some grouping of the work does occur. One field in which there is considerable activity is in the study of some aspects of echo-ranging systems, particularly of the acoustic type. Work is being done on the synthesis and performance of directional transmitting and receiving arrays, on the principles of rapid electronic beam swinging to provide sector scanning within the time duration of one pulse, and in determining some of the fundamental characteristics of visual displays used in echo-ranging systems. Much of this work is being done in conjunction with the National Institute of Oceanography and the National Research Development Corporation on behalf of the fishing industry.

Another field of research which has important industrial as well as scientific applications is that of electronic computers. It is not the present intention to deal with the construction and operation of large computers; work is concentrated on the basic elements from which computers are made. For example, an investigation has been made of ferro-resonance and its application to bi-stable elements. Small special-purpose computers of both analogue and digital types are being studied. In some ways associated with this work, but in others more with heavy electrical machines, is work on automatic control and, in particular, on methods for the determination, from data obtained in normal service, of some of those characteristics of industrial processes which are important for automatic control.

Another branch of work which has for some time been a major feature of the Department's research is that of the study of the electrical performance of materials. The behaviour of liquid dielectrics under electric stress has been studied for many years and is contributing to an understanding of the mechanism of breakdown. Research is now being pursued on the applications to electrical engineering of new types of material, particularly ceramic dielectrics.

A number of other research projects are also in hand, although it is to be regretted that so little of the work is in heavy-current engineering. Efforts are being made, with industrial encouragement, to improve this situation.

For several years now the Department has run Summer Schools at postgraduate level in a number of subjects, notably automatic control, electronics and communications. These have been well supported and have shown that there is a real need for advanced instruction in these subjects. Consequently, the Department is offering, starting next session, a graduate course of one year's duration entitled "Information Engineering." This is intended to be an academic though practically based course, leading to the award of the M.Sc. degree and covering information theory and its application in the fields of communications, electronic computers and automatic control.

The Department is, on the whole, enthusiastic about the opportunities which expansion has given it—although aware of some, at least, of the dangers. It wishes to play its part in, and perhaps even contribute to, the leadership of one of the country's largest industries—for electrical engineering is one of the three largest industries in Great Britain.

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