BROADER EDUCATION IN A TECHNOLOGICAL DEPARTMENT

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On the subject of the broader education of technologists—and indeed on the broader education of all people pursuing advanced studies—much has been said and written, but on the whole little has been done. The setting up of the new colleges of advanced technology has led to a considerable re-examination of the broader education requirements of technological students, and the Ministry of Education has clearly stated its views on both the nature and the amount of the 'Liberal' Education in all kinds of technical colleges. Perhaps the most important recommendation is that the total amount of time devoted to this aspect of education may add up to as much as 15-20 per cent of the total course time. Nothing like this is done in the universities, nor is broader education on this scale even contemplated, so far as I know, by most technological faculties and departments.

In view of all that has already been said about the need for broader education,[1] there is little point in repeating any of the arguments here. The need is widely accepted; the difficulty is in providing it.

One of the largest problems of introducing broader education into established technological courses—this is the university problem—is to find time for it in already crowded timetables. It is argued that it is difficult enough to find time to include those technological topics which are considered vital to the technologist's education. It is argued that the complexity of modern science and technology makes it desirable to add more technological subjects to the syllabus rather than to remove any. In my view, based on over 20 years' experience as a practising engineer before coming to the university as professor, these arguments are entirely fallacious. A great deal could be removed from any technological syllabus with quite negligible effect on the technologist's career. It is very doubtful, for example, if even 1 in 10 university-trained engineers ever makes use of the advanced mathematics he 'learns'. This is, of course, partly because there is no need to use it, but it is even more markedly due to the fact that the technologist is unable to use it. He has passed examinations in mathematics, he has been shown examples of those mathematics applied to technological problems, but he has been unable to learn to think of new problems in mathematical terms. In my view there is no case for increasing the technological and scientific content of undergraduate courses, and present courses can stand considerable pruning. This is not to say, of course, that more advanced technological and mathematical courses should not be given. They should indeed be given, but at the postgraduate level, to students who have had some experience in engineering after initial graduation.

If it is once accepted that time can be found for broader education, then the next problem is whether it should be done for the university as a whole or separately in each department. I think there is a need for effort at both levels. In Birmingham, for instance, the weekly Open Lecture at lunchtime, after a somewhat unencouraging first year or two, has now become a great success, attracting sometimes half the university population. It is, however, at the departmental level that efforts in broader education can be made to have more effect. In a large university, for better or for worse, it is usually the department to which students attach their loyalty. It is mainly the staff of their own department whom they get to know well. It is, therefore, the department which is in the strongest position to influence the students in their thoughts and plans. I think, therefore, it is essential for departments to make a strong individual effort to encourage broader education of their students.

For such departmental effort to be successful, it is essential for the departmental staff to take a large share in the broader education courses. If these courses were left entirely to specialists from other departments or from outside the university the students would not be impressed by their relevance to the life of the engineer. It is the fact that the engineering staff think the courses are important, that they themselves know enough about the subjects to do some of the lecturing, which will most strongly impress the students. It is unlikely, of course, that most departments will have many members of staff able to take part in this work, and, of course, outside lecturers must be used quite extensively. It is probably vital that the head of department should himself play a major role in the broader education courses.

Another vital factor in broader education is, of course, the choice of the subject matter. I do not think, however, that the *details* of the choice are likely to be vital, provided one general principle is adhered to. This is that the term 'Broader Education' should be taken literally. In other words the student's interest in his technological subject must be used as the starting point and the broadening subjects must spread from his technology. There is likely to be no profit—and indeed there may well be an irrecoverable loss—if the student is merely given new and apparently irrelevant specialisms. I feel the term 'Liberal Studies' is to be deprecated; in my view 'Broader Education' is the correct terminology, and it is the term used at Birmingham. The student must be shown where his technology impinges on other human activities. For example, it affects human relationships, administration by Government and commercial organizations, aesthetics, literature and art. In fact, it is related to almost all human activities, perhaps rather more in the present than in the past.

With all the above in mind, courses of various kinds have been arranged in the electrical engineering department of the University of Birmingham for some years. Considerable activity in this connection was started by my predecessor, Professor A. Tustin, and when I came to the department it already had a considerable tradition of broader interests; it has, therefore, been comparatively easy to extend this into the present pattern, which, of course, is still quite experimental. It was at first thought that the discussion group should be the basis of broader education. The students were divided into groups of about a dozen and dealt with on an informal and comparatively intimate basis in the lecturer's own room. The topics dealt with are described in more detail later. We have not been convinced of the success of this method, however, and later courses have included a considerable content of lectures which are normally 'compulsory' for all students in the year for whom they are provided; attendance of other students is invited. It was early found that these courses could not be made entirely voluntary; the majority of students have initially no interest in broader education nor any desire to be broadly educated. If their interest can be aroused, there is no difficulty in obtaining adequate attendance, but in the initial stages some compulsion is essential. It was found that students think that if a course is not examined, it is not thought by the staff to be important. This quite understandable reaction must be taken into account, and some form of examination provided for all the broader education courses. Both formal examinations and vacation essays have been tried. While neither is entirely successful, they do have the merit of compelling the students' attention. Students' discussion meetings have been organized at the end of each year; in these, the staff play no part, except to appoint a chairman and then to attend. The students give talks, and conduct discussions, on the various topics that have been dealt with; it has been found that this is most effective in arousing students' enthusiasm and the standard of performance has been surprisingly high.

Great care is taken to avoid any growth of resistance or of a feeling that the work is irrelevant; illustrations of practical situations involving all the factors discussed are given as frequently as possible. Fortunately most of the staff can speak from considerable experience of engineering practice. The choice of outside lecturers is important. It is desirable to choose people who have been reasonably successful in their careers and who can illustrate that they practise what they preach. The course described below on 'Design in Engineering' has given good opportunities for this sort of thing.

(a) *Discussion Groups*

It was thought that one of the objects of these discussion groups, which were held in the student's second year, should be to develop the student's ability to express himself in speech and in writing. One series of discussions was, therefore, devoted to the analysis and reconstruction of the student's own efforts at writing a very short essay on some provocative subject, preferably relating to technology. Errors in English and in style were discussed, causes of spelling errors were examined, and in each case a reconstructed essay was produced which met the criticisms of all members of the group so far as possible. These exercises, curiously enough, seemed to be enjoyed by the students.

In another group the impact of technology on society in the industrial revolution was taken as a general subject, to be examined through good-class novels of the period, such as *Mary Barton* by Mrs. Gaskell and *Shirley* by Charlotte Brontë. This gave an opportunity for the students to read aloud. It may be added that at the beginning their standard of reading was absolutely appalling; they could have had little practice at school. In this course, unfortunately, it was not found easy to stimulate good discussion. In a closely related course, in which the history of the industrial revolution was examined through one or two good modern books, the same difficulty of stimulating intelligent discussion was found. On the other hand, vacation essays submitted by the students on these topics were of surprisingly high quality and indicated that the students had in fact read fairly considerably for themselves. In no case, however, did the students appear to show any enthusiasm for the prescribed books.

Another group devoted its time to play reading; although this gave less opportunity for developing individual thought, it had a most marked effect on the students' quality of speech. Indeed, a professional examiner, who was invited to hear the students, was full of praise for them.

(b) *Courses of Lectures for Students in their Second Year*

Two courses have been organized, of 10 and 8 lectures respectively; both are given in the same term. The first course is entitled 'Design in Engineering' and is intended to emphasize the breadth of interest in the engineer's life and the breadth of the considerations to be taken account of in design. The introductory lecture by the Head of Department reviews the whole field, describing the criteria of design, such as fitness for purpose, suitability for the proposed environment, relationship with the human user, etc. Examples of good and bad design are shown and the relationship of aesthetics and efficiency discussed. The remaining lectures have been given by practitioners in various branches of technology, including the architect who designed the department's new building, the professor of civil engineering who has had considerable experience of bridge design, a very successful designer of domestic equipment as well as of houses, and the head of an engineering group in a large Government establishment. Members of staff give lectures on several design topics, including one on the effect of discovery on design, and another on design for production.

The second course is on government and management in relation to the technologist; members of the department's staff give lectures on technologists in management (3 lectures), Government research and its influence on industry (4 lectures) and research and innovation in small firms (1 lecture).

(c) *Lecture Courses for Final Year Students*

The main lecture course provided for final year students is intended to provide some measure of integration of the historical, sociological, economic and scientific background of technology. It comprises about 35 lectures and starts with a fairly rapid survey of the development of technology and its relation to civilization from prehistoric times through the stone, bronze and iron ages. After this introduction, consideration is centred on Britain, and the effect of technological developments on patterns of industry and settlement are reviewed. In considering the period from the eighteenth century onwards, more detailed consideration is given to this question of technology in relation to environment. The consequences of the industrial revolution in regard to the living conditions of the people and to the changes in social structure are discussed quite fully; and several lectures are devoted to the history and present status of trade unions.

The development of British industry into the twentieth century is considered specifically in relation to world economy in another group of lectures, which includes an examination of the manner in which industries and firms develop, a discussion of monetary factors, and an account of the proposed European Free Trade Area.

This main lecture course is concluded by a group of lectures on the influence of scientific research on the developments reviewed in the rest of the course. The course as a whole is very much an inter-faculty affair, although run specifically for the Electrical Engineering Department. All the lectures, except the last group, come from the Faculty of Arts or the Faculty of Commerce and Social Science.

In parallel with the rather comprehensive course described above, a course of 14 lectures is given by the staff of the Department of Engineering Production on the problems arising in the organization of the production side of industry—factory lay-out, management, etc.

The results of the last three years' work on broader education for electrical engineers suggest that this can be successful in the sense of arousing some genuine interest in the topics discussed. The standard of essays submitted has been good; the standard of talks given in the students' prepared discussions has also been good. Impromptu discussion, however, has always proved disappointing. One sign of the genuine interest in broader education aroused is that students of the electrical engineering department appear to have attended the general University Open Lectures rather more conscientiously than most other students.

It should be emphasized that obtaining a pass mark in the prescribed essays and in examinations on the broader education courses, where these have been held, has been a condition of the award of a degree. In other words broader education has been given the same status as the strictly technological subjects. It has been found that the students who do well in technological subjects also tend to do well in broader education subjects. The worst failures in the latter are those who fail their technological subjects anyway. While this is not an unreasonable result to obtain, it is contrary to many people's ideas that the successful technologist is necessarily (or likely to be) a man of narrow interests. It is encouraging to think that a brilliant technologist can also take his part in society as a person of high education.

NOTES

Although the opinions expressed are my own, the departmental work described has involved six members of the staff; and many other people, inside and outside the University, have willingly co-operated. In particular, great credit is due to Dr. D. A. Bell, Mr. J. T. Allanson and Dr. E. E. Ward who have given a great deal of time, effort and enthusiasm to the experimental courses.

[1] See, for example, 'The Education of the Technologist', three papers by N. R. Hanson, J. Pilley, and D. Krook, *Universities Quarterly*, 11, ii, 1957.