

The solution of this condition lies in the development of courses within the engineering schools which shall be specially devised for commerce school students who are interested in engineering, and the development in the commerce schools of courses which are specially devised for engineering school students interested in management and administration. The restrictions of time and the lack of inclination of most students to spend more than four years in college make it highly desirable to devise these special courses rather than to attempt to have students in one school take the regular routine of courses in the other school before they can secure the advanced courses which they may desire. The special courses both in the Engineering School and in the Wharton School of Finance and Commerce, which have recently been developed by the University of Pennsylvania and other institutions, indicate some of the possible developments along these lines. Of course, experience will modify the particular courses and their content from time to time. However, the idea of a special course in one school for students of the other school seems to be inherently right.

In considering a curriculum for training for management of manufacturing industries, it is essential that we keep in mind the large numbers of manufacturing industries in which metal working plays little or no part. In textiles, paper, shoes and food manufacture, many of the courses which are outlined in the curriculum laid down in the paper under discussion would not be valuable, although substitutions could be made in some cases from the field of chemistry and chemical engineering. Nevertheless, a full consideration will promptly indicate that the basis of training for such manufacturing industries may, perhaps, better be the commerce course with engineering options rather than the engineering course. And when it is further considered that students, as they enter college, have knowledge of their future vocation in but a small percentage of cases it becomes even more important that we should train broadly for the field of manufacturing rather than for any particular type of manufacturing. Even though a student may be interested in manufacture, and even though he may feel definitely that he is going into a particular branch of manufacturing industry, we all know that (even should he stay within the fields of manufacturing) the particular industry into which he enters will very likely depend on specific opportunities at the time of his graduation.

P. F. Walker<sup>12</sup>: Messrs. Roe and Burleigh have given in their paper an interesting survey of what is coming to be a real education problem. Business and managerial training has been approached from two different angles, and it is becoming necessary to decide questions as to scope and character of curricula appropriate to two distinct sets of conditions. I have found that university administrative officials are looking in these days for effectiveness in organization of the work that is to be offered, and there is need for defining the divisions of the field which shall be assigned to industrial engineering on the one hand and the production branches of the schools of commerce and business on the other.

There is one criticism of the paper which I propose to make at the outset. The two proposed curricula are too much alike. The differences are not sufficiently definite to indicate clearly defined purposes for these two branches of our educational institutions. It is in my belief that our industrial engineers should be primarily engineers, fitted to take positions which our mechanical engineers take regularly. On the other hand the graduates from our schools of commerce should be ready to enter upon these positions which they naturally take, with good and sufficient foundation for that work. This does not mean that there should be no interchange. In fact, my thought is based strictly upon the proposition that each curriculum should contain a sufficient amount of the work in those lines which are distinctively of the other sort so that the graduate from each may have a fairly intelligent understanding of the problems which are inherent in the other. But the primary objective in each branch of work should be clearly of the nature appropriate to the one class of work or the other.

The line of approach of the engineer to administrative and managerial positions is clearly defined. Graduates of our schools of engineering, men who have taken the regulation courses, have been going in large numbers into positions of this character. Extensive studies of the records of alumni in various institutions have revealed on the average that nearly two-thirds of all those who remain in those occupations which are related to industry and construction are in positions of administrative character. The schools differ in this respect. In the case of one prominent school, the proportion engaged in this class of work runs almost constantly at two-thirds after

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the men have been out of school five years. In another institution it happens for some unknown reason that the proportion is only one-third. Some years ago I made a study which covered the records of 1,000 mechanical engineering graduates and found the number in positions of administrative authority to be almost exactly one-half. This means that the definite approach to positions which have relationship to the business and administrative sides of industry is well defined for the regular engineering graduate.

It should be noted also that industries at the present time are looking definitely for engineering graduates for men who are to advance to administrative positions. I frequently place graduates with the Portland Cement manufacturers. Managers of these plants tell me that it is their intent to recruit their superintending and managing staff from these engineers. The Corn Products people tell me that they have a definite policy of advancing no one to the position of plant superintendent who did not come through the ranks of the engineering staff where they would become thoroughly acquainted with the heat and power phases of operation. Machinery sales work is being manned almost entirely from the ranks of engineers. While sales work is not in itself managerial, it represents an activity which would be classed among the business subjects. I have personal knowledge of many of these men who go directly into sales work, and who have advanced into the managership of sales. These illustrations are given merely to show that men with engineering training have found their way into these branches of work, and that industry has learned to look to the engineers for this service.

Now my point in criticizing the industrial engineering curriculum which has been presented is that we should not discount the advantage which has already been established. The line of advance has been definitely established, and we do not want to start turning out men, designated as engineers of any class or type, who are not fully equipped to fill positions where they will be expected to perform work of an engineering character. We cannot afford to give up the advantage. It is entirely possible to give the men this training which is basically engineering and at the same time give the men whose inclinations lead them in that direction a fair amount of work which bears more directly upon the economic and business side. It is

somewhat difficult to do this in a crowded curriculum of a four-year course of study, but some of us are doing it. It means replacing some of the more specialized courses with other courses given in the school of business. In my own school, out of 140 hours required for graduation, the man in industrial engineering are given about 20 hours in economics and business, and 11 hours in industrial engineering subjects. These men are given all the basic courses in mathematics, physical science, and engineering, just as are the mechanical engineers. I believe firmly that they need this training, which includes the calculus, so that they may take their places in industry alongside of other engineers.

It is my belief that graduates from the school of business and commerce also have their direct lines of approach. The training as outlined in the paper for the school of commerce appears to recognize that fact, and it appears to me that it carries out for that group the thought which I have expressed in connection with the engineering branch. I am not so familiar with conditions in that general field, and have not had opportunity to study this paper closely for the purpose of determining whether or not the suggestion made is adequate to meet the principle which I have indicated. It is my belief, however, that it does meet that thought, while I fear that our engineering friends in their zeal to lead engineers into the administrative path have gone too far away from the engineering curriculum. There is no need for the engineering schools and the business schools to merge. While the product of these schools may sometimes reach over and overlap in the field of business, nevertheless each group has its own function and its own line of approach. Some men fall more naturally into one while others fall into the other. Their approaches to the economic problems of business are along different lines, and if they have chosen their course of study properly in the beginning they will be in the best position to advance if their course of study has been such as to qualify them for the work which first comes to their hand, while giving them in all cases the larger vision which will stimulate growth through which will come ability to deal with the larger problems in due season. Let us recognize this difference and not permit the two curricula to become too much alike.