OPPORTUNITIES FOR CONTINUING EDUCATION AND ADVANCEMENT OF THE YOUNG ENGINEER*

PART I

By Russell G. Warner, M-CSCE
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WHAT are the opportunities and what can we do to improve the opportunities for continuing education and advancement of the young engineer in Connecticut? Various views of this subject will be ably discussed by the members of this panel.

What should we say to the young engineer as to his opportunities? What should he do to help himself? The Engineers' Council for Professional Development through its Training Committee has studied this problem and has many worthwhile suggestions. During the past two years, it has undertaken a concentrated program for development of the young engineers in the Cincinnati, Ohio area. Many of my remarks are guided by their reports.

First let me say, I believe that usually the real opportunities for advancement depend on the effort and good judgment of the young engineer himself. What kind of a position did he select? Did he choose it on the basis of immediate financial return or on the basis of the opportunities to learn and obtain good experience? Is his interest in the pay with minimum effort or is it in doing a good engineering job? In short, what is his attitude? In speaking to you, the young engineer, you should prove your ability, develop a high sense of integrity, and identify yourself as a member of your profession.

You have all heard of not being able to see the forest because of the trees. Frequently, I have seen the young engineer who has become a specialist on a component part of a complex unit without bothering to orient himself to the whole. Don't permit yourself to stay in a rut until it becomes so deep you cannot see over the edge. Be alert and inquisitive, review plans and reports which are available. Learn about your company, about your department, about other departments. If there is an orientation plan, make the most of it. If not, obtain supervisory approval to visit other sections of the plant or project.

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Recognize that an engineer's education is never complete. This is not unique for engineers. It is also true of other professional people. As scientific knowledge is unfolded, the application by the engineer is brought into being. Plan for further study. In some cases this may be by formal courses at one of our colleges. In many cases, it will be through self study of the technical literature as well as that of a more general nature. Those of you who have been fortunate enough to have had four years of college will soon recognize that many phases of education have not been adequately covered. Most of us know too little about the how and why of human behavior and consequently, too little about the full effects of our technological developments. You may be aware of some of the needs of communications. Frequently it is necessary to make reports to convince a non-technical person of the need for an engineering development. Good English and logical arrangement of ideas is imperative. Probably this is not the place to call attention to the fact that many of our young engineers are very careless spellers. I hate to believe they don't really know how to spell, but poor spelling creates a poor impression of the man.

Don't be a hermit! Become a part of your community. Make an effort to live with other people. It will help to find out about the important work other people are doing and to let them know about the important work you are doing (providing it is not restricted). Assume a reasonable activity in your community. This might be in church work, in a neighborhood club, boy scouts, etc. Engineers have a responsibility to participate in local, state and national affairs. The place to start is where you are living.

Start immediately to identify yourself with your profession. If you went to college you were probably a student member of one of the national engineering societies. Maintain that contact through transfer to regular membership. Actively participate in one of the local sections of a national engineering society or of a state society such as this. From time to time review your professional code of ethics. Make it your guide. As soon after graduation as possible, take the examinations to become an Engineer-in-Training as the first step toward becoming a registered Professional Engineer. After you have had adequate qualifying experience you will then be permitted to take the professional examinations. Your experience must show increasing competence in engineering work. To obtain four years of qualifying experience, it usually requires a minimum of five or six calendar years. And unfortunately, we find young men who have not developed as engineers though connected with construction or other technical work.

From time to time review your progress and your job. Check your personal qualities and abilities in relation to your job and in relation to other jobs ahead.

Quoting from E.C.P.D. "Periodically, a young man should analyze the personal and technical requirements of his job and other jobs for which he may qualify. It is equally important that he take stock of himself so as to use his abilities at the highest possible level and at the same time to strengthen himself wherever there are shortcomings.

"It is impossible to over-emphasize the fact that technical competence is the NECESSARY but not the SUFFICIENT condition for becoming a professional engineer. There must be developed, in addition, certain personal characteristics, qualities of personality and of character, which will establish unmistakably a feeling of trust, confidence, and loyalty in man to man relationships".

In looking over this group, it would appear that many of you are employees or supervisors of young engineers. What are you doing to develop the young engineers in your jurisdiction? Are you accepting a definite responsibility to develop a truly professional man? Are you assisting, to provide the best environment so that he will develop and be a credit to our profession?

There is much you can do to guide him, and to improve his opportunities for advancement. Encourage him to broaden his perspective. Minimize the amount of routine duties, and in so far as possible present opportunities for him to do creative work and assume responsibility. Assist him in learning more about other portions of your business so that he can see how his duties integrate with those of others to make the whole picture.

Perhaps you can guide him in his reading and in his continuing education so that he may be prepared to progress to other duties. If further formal education is desirable, attempt to arrange work schedules so that he can take desirable courses. Such courses might be in technical fields or in other types —for example public speaking or certain aspects of getting along with people. In some cases financial assistance may bring worthwhile returns.

You can help him to get started in participating in engineering society activities. Encourage him to identify himself with our profession through becoming an engineer-in-training and after sufficient experience, through registration as a professional engineer.

It is desirable to discuss with him his development, his shortcomings and his strong points. Keep in mind that as this young man develops professionally, he should become a more valuable employee. As I have said before, the young engineer must help himself, but, I urge that we older men do what we can to create a stimulating environment.

Now we will ask Professor Lockwood to discuss educational aspects of this picture.

PART II

By Prof. Harold J. Lockwood
Head of Department of Engineering, Trinity College

When I was asked to discuss advanced education for Engineers from the standpoint of the college professor I approached the acceptance with some doubt in my mind. One is reminded of the books, such as, "Sound Investments" authored by a man worried about his next house payment or rent; or, "Married Happiness" written by a bachelor. We teachers, I am afraid, are looked upon as being in "Ivy Towers", or textbooks wired for sound, and are not fit to teach advanced engineering. However, I fail to see where fundamentals have changed very much even with the increasing important and demanding responsibility of today's technological environment.

Mr. Bodley, of Convair, in a talk at the annual conference in January of the Institute of Aeronautical Sciences held in New York, said that the need for engineers with advanced engineering degrees indicates that at least 50% of the additions to their group of the Engineering department should have advanced degrees. In some areas specialization in graduate work is not as desirable as a sound general program at the graduate level. I believe we are moving into areas of investigation which challenge the abilities of even our best and most highly qualified people. If we do not do something in this field as well as the undergraduate field we face a fantastic technical nightmare. There is no doubt that how far we can go into new technical discoveries and developments will be in direct proportion to the level of training which is available both in the engineering schools and in industry. The factors which set an All-American broken field runner above others are similar to those which should increase the value of advanced work, despite the fact that we still need plenty of linemen and a good bench, or depth.

True engineering does not necessarily mean increased complexity. The most satisfactory solution to the problem of a leaky fountain pen is not the introduction of a pair of rubber gloves. A good engineer is one who can draw sound conclusions from what is quite often very insufficient data.

Whatever our curriculum may be we must stick to the 4 M's, since we have progressed from the 3 R's. MEN, MATERIALS, METHODS and MONEY are the important items. A possible modification of the 4 M's might be: MATHEMATICS, INTEGRATION, INTEREST and COMMUNICATION. Apparently there are many colleges which teach many subjects apart from and without relation to the basic engineering program. We must try to do away with compartmental type of courses, or have the student get the impression that the course may be pigeon-holed when completed. How many ideas go astray for lack of proper communication?

Considerable advanced study can be carried on in the form of self-education. The average college student or graduate should have learned how to

study and even if no advanced courses are available he should study one or two nights a week as a minimum, even if it is only a review of some former course. It is amazing how much one can pick up by such a method if done consistently.

With all the advancement of computing machines and a tremendous amount of research, there has developed too much manipulation. Too much grinding out of formulae resulting in—sausage. These methods are becoming tin gods and may overwhelm us. We must keep our feet on the ground and learn common sense, despite our ambitious aims.

One should take advantage of courses offered in local area either with the company or local colleges. Our experience at Trinity with one exception, has not been too good. First, quite a few people are not acquainted with the set-up at Trinity and do not realize what we can offer in the way of Engineering studies. Second, we have offered a number of courses through the Evening Division from time to time, but the men were either ill prepared or not sufficiently screened so that after a few weeks there were but a few left in the course, and we became discouraged and stopped offering any more. There is one course however, the exception I mentioned before, that has been quite successful. It is the Refresher Course given to men preparing to take the Professional Engineers examination which the State Board gives before granting a License. Here we have offered two parts: the first covering the basic subjects such as Mechanics, Mechanics of Materials, Heat and Power, Electricity, Fluid Mechanics, etc. The second part covers the advanced or professional experience. We ask a number of Hartford engineers to assist in this part. The whole course being sponsored by the Hartford Chapter of the PE's. The enrollment has been high and the men that have taken the course have been quite successful in passing the State exam's despite our help. There is no doubt that our department would offer other courses should the demand be there. Our director of Extension, Mr. Vogel, would consider courses should a sufficient number qualified to take the course make their wants known.

I believe there is too much emphasis placed upon the degree and not content which earned the degree. There is too much shopping around to get an easy degree. We had a case recently where a man who had graduated from college wrote his brother, then in college, and gave him a list of instructors names. He then told his younger brother: "Don't take their courses, you will have to work too hard". In other words, one must have the proper attitude and aptitude for advanced study and not just pick up odds and ends. When one ceases to ask questions one is apt to become foolish. Our curiosity must be constantly aroused. We all have a tremendous amount of energy to devote to the development of our abilities.

One other opportunity awaits a number of young men in industry and that is part-time teaching. One learns a great deal when endeavoring to

teach a class. In the course of the last few years we have used quite a few from the outside. We may need more of you because I heard the other day that there is to be introduced into the college football scheme; the three-platoon system. One for offense, one for defense and one for study!

Thank you.

PART III

By Byron F. Wilcox, M-CSCE
Assistant District Plant Engineer, S.N.E.T. Co.

The young engineer enters into an industry with a degree and some educational background, but this background must be developed and broadened from the standpoint of each Company in order to properly utilize his skills. Each Company has its own very specific problems, requirements and needs which must be presented in an adequate way to this new employee. Usually each industry that employs engineers has an established program for the training and subsequent advancement of the young engineer. These programs vary in scope with some much more elaborate than others but the goal is essentially the same. It would be impossible for me to outline all or even part of the approaches taken to the problem. Consequently, I shall limit my remarks to an outline of the approach taken by the Telephone Company in the training and development of the engineers in the plant department.

Perhaps it is well to look briefly at the duties of the plant engineering organization in the telephone industry. It is responsible for the engineering and the issuance of plans for the construction of all telephone facilities outside the central office building. These facilities consist of pole lines, wires, underground conduit and cable systems. A portion of the work is in the field, as is that of the Civil Engineer. In the performance of the work, the engineers in this group are in contact with the engineers of other utilities, highway departments and municipalities, with town officials, real estate developers, contractors and property owners. It is probable that many of you have contacted members of the group. In addition, the engineer has to coordinate his work with other departments within his own company. The work is usually done by an individual rather than by a group, and this fact has a bearing in the type of training that must be accomplished.

The engineer who enters the telephone plant engineering organization as a college graduate normally has a degree in either civil, mechanical or electrical engineering. In addition to these men, there are many engineers who have advanced from the ranks of plant craftsmen—such as linemen, cable splicers or central office men. These men have been able to do this by increasing their technical knowledge as a result of utilizing the facilities of

various educational institutions in the state, which offer evening courses in engineering study. Once accepted as a member of the plant engineering department, the training and advancement opportunities are the same for both groups of men.

There are two general methods of training that can be utilized—either on-the-job or at a centralized school. Each method has its own advantages, both for the individual and for the company. After various trials, it was decided that a combination of both methods was the most practical. The on-the-job method is used initially and, in the overall, constitutes the major part. Consequently, the young engineer is assigned initially to a district office and his training becomes the direct responsibility of his supervisor, a Supervising Engineer. If he is new to the business, it is necessary for him to become acquainted with the appearance of the various items of plant, their uses and names. If he is from another group in the business, he will have new items to become acquainted with and new nomenclature to learn. In order to accomplish this, he is assigned to work with experienced men on a variety of jobs. As his basic knowledge increases, he is gradually taught the use of the necessary practices and specifications. One advantage of the on-the-job training is that it allows the training to be tailored to fit the individual, and his progress will depend on his ability to absorb new things.

This type of training continues for a period—six months is normally the minimum—and then he is assigned to attend a centralized company school with a group of engineers with similar experience. This school is taught by a Supervising Engineer from one of the districts. Prior to the class work, the Supervising Engineer works with the training department and receives instruction in the principles of vocational instructor training and in conducting such a program. Each school has a different instructor. This method spreads the experience among all of the Supervising Engineers. It is felt that this has merit above that of merely getting the job done. First, it utilizes the practical knowledge of a field supervisor who is currently working daily with on-the-job engineering problems; secondly, the Supervising Engineer returns to the field with additional knowledge in the art of his profession and increased ability to impart this knowledge to others.

The class room work is kept very informal and discussion is encouraged. The various items that the engineers have encountered in their field training are reviewed with emphasis on understanding the engineering principles involved. Individuals from other departments, who have special knowledge, are invited to present specific items. Every effort is extended to have these new engineers not only understand "How but also "Why." Their future work will be of such a nature that it is essential that they know a great deal about the responsibilities of other departments of the business and understand the overall cooperative effort necessary to provide telephone service.

The engineer returns to his office to continue on-the-job training under

the direction of his own supervisor. As his ability increases, the complexity of work assigned to him also increases. This continues for a period of six months or more and then he again attends the centralized school with the same instructor and group as before. The same procedures are used as at the first school but by now the engineer has had a year or more of field training. His work experience has developed him sufficiently to result in more technical questions at this school. As previously, individuals from other departments present special items such as transmission design, electrical protection and cable pressure systems. Economic design, as it applies to the use and extension of outside plant, is studied. It is endeavored in each subject to present enough overall theory to provoke the engineer's natural interest and inquisitiveness. At the end of the school the engineer returns to his office to progress and develop on his day to day work.

Materials and methods of the telephone business change rapidly enough to make training a continuing item with all engineers. It may be done individually, in groups or in a centralized school—whichever is the most practical at the time. Engineers are rotated on the various types of work in the district in order to develop well rounded individuals rather than specialists. Whenever possible, job rotation into other departments or into our headquarters plant engineering organization is used to broaden the background of the engineer.

To sum up, our program is not static. It is continually under study for improvements and changes. The postwar expansion of industry has pointed out the need of further training for engineers of all levels. Despite our heavy work load, we are contemplating the expansion of the training program for the more experienced engineers. Our training program has been very successful in developing competent engineers and in preparing them for advancement as opportunities became available in the business.

PART IV

By Lawrence P. Johnson, Jr., M-CSCE
Civil Engineer, Metropolitan Water Bureau

I was asked to join this panel in the role of a young engineer who is engaged in part-time schooling. I thought for a long time before deciding how to tackle the assignment and ended up by asking why any practicing engineer should take more scholastic work.

I'd like to outline briefly some of the thoughts that came to mind in attempting to answer this question. I realize that they may be of interest to a rather limited portion of our membership, since I can talk only of the formal post-graduate courses I've had contact with at the University of Connecticut. Probably the outside operating engineer will see little merit

in these courses, but certainly any design or laboratory man can derive some benefit from them and, to anyone connected with the teaching phase of engineering, they become a necessity.

In our under-graduate work, the scope of each course was determined by the department head and his staff and, to hold their accredited status, very limited variation was permitted in the subject matter. In part-time graduate work this condition is the exception rather than the rule. Except for a few advanced, though classical, theory courses, the scope of most sessions is fitted to the desires and needs of the students. Apparently, from the low student to instructor ratio, these courses are not money-makers for the university but we, the students, benefit immeasurably from the situation.

To cite an example; in the fall of 1953 a course in Advanced Structural Analysis & Design was offered at Storrs. Two students took advantage of it, myself as one. We elected about six subjects to consider in the course from a list of a dozen or more the instructor thought would be of interest and use to us. We selected a day and time to meet and occasionally varied it from week to week when it interfered with outside commitments of one of us. The total tuition income to the school was $60.00, but we two students, and the C. E. profession indirectly, received about $700.00 worth of the instructor's time, knowledge and experience. I include this example to illustrate the vast difference between the informal, part-time, graduate work and the full-time under-graduate work we are all familiar with.

Certain sacrifices must necessarily be made to take these courses. If working toward a graduate degree, a certain minor percentage of the courses must be taken on campus. This requires one round trip to campus each week, which is not an advantage after an eight-hour day at the office. Courses meet for one three-hour session each week and, as an average, outside work runs another 3-6 hours. Taking this time from that available for family, hobbies, social commitments and recreation is, no doubt, a sacrifice, but a disadvantage in the short run only.

Financially, there is a short-run disadvantage of $30 per course.

Certain of the advantages to be realized tend toward the philosophical, so let me subdivide them into the tangible "dollar and cents" advantages and the intangible, or what we might call the long-term advantages.

First, since graduate work is not compulsory, our friends, our employers, and we ourselves, realize that we are willing to make some sacrifices in an attempt to better ourselves. Our employers do not push us up the ladder of success, but if we climb they'll generally follow up with the safety belt. To me, this aspect is a dollar and cents advantage.

Secondly, and probably most important, we are learning new and better ways to perform our chosen tasks. When we climb a rung on the ladder we have the knowledge and the insight to do the work at that level. This aspect is, no doubt, worth many dollars and cents to us.

Thirdly, in the generally small classes, we develop close personal contacts. The instructor is not just the fellow at the blackboard, he is the fellow that sits between us at the seminar table and inspires us personally as well as professionally. Our fellow students are, like ourselves, trying to advance in their field and they're good fellows to know. In our day by day life, they are the caliber of friends that can help one another professionally.

As to the long-term benefits, after a number of graduate courses, we may become eligible for an advanced degree. This degree itself does not guarantee success, but it does open the door in most cases, of two comparable applicants for a position, the one with the advanced degree will generally get first crack at it. His success in it will depend on his initiative, education and ingenuity. That he possesses these traits he has proven to himself by the completion of this voluntary graduate work. It is then an almost automatic step to inspire confidence and prove it to his employer.

Another of the long-term benefits is a mental "frame of mind." I think it is best described by calling it a habit of study. To illustrate, many of us in the Hartford area have taken Professor Lockwood's refresher course at Trinity in preparation for the state exams. Professor Lockwood did not tell us the answers (he might have had he known the questions), but I for one owe my state license in part to him for redeveloping the habit of study, the tactics of approaching a new problem. It could also be called an interest or desire for knowledge. How many of us, eight or ten years out of college, have heard of limit design, semi-rigid joints, plastic creep and similar terms? Most of the work on these new approaches and questions is being done at the universities, by the same men that teach these courses. Do we, in industry, feel confident to discuss them? How often do we pick up an A.S.C.E. separate and read only the introduction and conclusion? We are the men who will apply these theories if they become accepted practice. As a direct result of this graduate work, I have come to feel that we must develop an interest in them, perhaps even to the point where we can add a voice in their evolution.

In conclusion may I say that many of my associates have told me that their lack of interest in graduate work stems from the type of courses that are offered. In certain specific cases, I will agree but, since we are the men that know what courses we want, we need only let the university staffs know of our desires. The mechanics of initiating special technical courses, and acting as the clearing house for our educational desires, I feel is one of the functions of a society such as this.

I have enjoyed the opportunity of joining this panel since, in doing so, I have crystalized my reasons for continuing formal education. If I have helped, in part, to interest any of you in continuing, I will feel my contribution was worthwhile.