OVERVIEW AND
SOME CURRENT THROUGHTS

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"Should the useful in life, or should virtue, or should the higher knowledge be the aim of our training?" Aristotle

From the founding days of the first organized institutions of higher learning (the academies of Greek antiquity) the major concerns and debates of the academic communities ultimately led to the basic question asked by Aristotle more than two thousand years ago. The penetrating thought and the elegant essays produced by those who succeeded in answering the question in their specific setting, time and place, have had profound effect in shaping the great intellectual centers of Western culture as they developed. This was true in medieval Europe as well as post-Sputnik America. In some ways the causes which trigger the concern and the debate and lead to Aristotle's basic question are also of great importance. In any case the question is answered for a time, and then it is up for discussion again. It is not surprising then that essentially the same question is back with us as we reflect upon the topic of engineering professional education. However this time the setting is strictly American: American culture, American institutions and the American economic-social-political system.

Engineering education was first offered formally in the world by the French (in their military schools), but it was in the U.S.A. that engineering gained its momentum and its preeminence. Indeed it is recognized throughout the world that Engineering Colleges (or Schools) in Universities are on American phenomenon. We shall not attempt to analyze, historically or otherwise this phenomenon. We do wish to point out however, a most remarkable fact: in less than a century since the Morrill Act which created the land-grant colleges, engineering education in the U.S.A. has come to co-exist on equal footing (and in some cases to lead) with other fields in the most prestigeous Universities of the land. This did not happen in Europe. Moreover, the Amer ican success was not an accident but the result of deliberate thoughts and actions in response to pressures and changing opportunities. The number of studies on engineering school activities in the last 80 years testifies to this. What makes this success an even greater achieve ment is the fact that "quality" engineers were educated and in "quantity" big enough to meet all demands. Nothing would be more in keeping with the best American traditions: open opportunities and generous rewards for hard work. But the success goes still further when one considers that engineering practice and the American life-style influenced each other in other substantial ways. Technology penetrated indeed altered some of the basic institutions of American society while American capitalism expanded the horizons and rewards of engineering practice in important and new ways. No wonder engineering educational benefits offered to war veterans had their greatest impact on engineering. No wonder engineering colleges with their four-year undergraduate baccalaureates flourished on Campus throughout the land, in the fifties and sixties. However, even the most casual observer of American life is now aware that a remarkable transformation is taking place in our society as we edge into the eighties. Should these changes alter the goals of engineering education as they were hammered out during the last three decades? Why? Engineering education in the U.S.A. has always recognized the fact that engineers are practitioners of an art which uses science for human service. In the past two decades or so it became important educationally to recognize that facility with basic mathematical and scientific concepts was essential to engineering practice. The importance has been universally acknowledged (witness the number of doctorates among us). And yet, there was always a tension in the atmosphere. Suddenly in the seventies voices began to be heard expressing concern about the "professional status of the engineer", about the "professional responsibility of the engineer", about the "professional conscience of the engineer", etc, etc. Let there be no doubt in any

educator's mind. Professionalism is now a matter of major concern to working engineers, to our industry and to our government. But it also preoccupies an ever increasing number of students who seek careers and future opportunities.

Why should the matter of professionalism (real or imaginary) have any substantive bearing on engineering education? It is not difficult to see the point by asking another question. Are all engineers professionals? If yes, then engineering education is by necessity professional education. But suppose we are willing to admit that there are some engineers who are professionals and some who are not. Then one can understand immediately such concerns as: 1) how is it ensured that a particular institution offers engineering professional education, if it so desires and/or it so claims 2) how do you educate professional engineers?

Thus we see that the concept of what constitutes a professional is crucial to our discussion. The answer historically is deceptively simple. During the middle ages schools were founded where young men learned to profess Christian learning and to apply it subsequently in the fields of "divinty", "law" and "medicine" - the three learned professions. These professionals occupied a very special position in the society both in the way they served and in the way they were rewarded, precisely because their learning involved higher principles than those made by men and material nature. This is a very important feature on which the concept of the professional rests and which we have rarely seen stated before. We shall return on this point later.

At least until the turn of this century the notion of a professional as an abstract concept was not important to anyone. The domains of the three "professions" were well safe-guarded by the roads that lead into them, the school themselves. Engineers most definitely were not professionals, even in cases when all other features (except professed learning), such as client relationship, form of compensation,etc., including importance and responsibility to society were met. For example, during the time of the western expansion, civil engineers educated at West Point left the military and subsequently worked as autonomous agents with incomes of the order of $10,000 per year from client fees. At that time University professors received a salary of $1000 per year - this certainly says something about the importance of the civil engineer at that time. However, they were not regarded as professionals.

During the first half of this century matters have changed substantially. New professions have been established and new avenues and

pathways to leading to them have become available (like the four-year American-style college). In the last decade social changes have had an even greater effect on the concept of the professional:

a) changes in the work setting in which professionals operate. The majority of professional services are no longer provided by single autonomous practitioners. They involve various kinds of organizations, private and public institutions, and payments are made in the form of combinations of fees, salaries and other equities.

b) changes in who the clients are. No longer are they exclusively individual clients, but groups, associations, and even entire organizations.

Ironically technology and engineering contributed to this change in a substantial way. In order to support large capital investments required for hardware and special facilities, professionals found it necessary to organize themselves into groups large enough to justify the investment. This in turn raised such questions as "professional jurisdiction" and "professional coordination".

Social changes in the last two decades have also brought about new emphasis on education through job related courses, community colleges, evening colleges and even open-universities. To the educational community all these changes have resulted in many strains, even in the operation of the traditional professional schools, to the point where their goals are challenged. Thus, the most satisfactory way to study the questions associated with engineering professional education is to examine thoroughly the concept of a profession. Investigators are doing this from the historical point of view and from comparative case point of view. We see the need and the potential of examining professionalism as it applies to engineering, from an abstract intellectual viewpoint in a social-scientific sense.

We advance here the hypothesis that professionalism can be understood in terms of several abstract cultural dimensions with universal meaning, such as science, mathematics, ethics, aesthetics, etc. That is, in the same way that science and mathematics have come to be recognized as accepted dimensions (not the only ones) to measure engineering practice, so ethics and aesthetics should be recognized as accepted additional dimensions (not the only ones) for measuring engineering professional practice. To put it still in another way,a professional engineer as he practices in our capitalistic society should be able to ask (and answer) why and how something is been done, not only in

terms of scientific principles but also in terms of humanistic values. There are few among us who would disagree with the desirability of similar objectives. We are optimistic that engineers can be educated professionally in our universities. This is why intellectual pursuits in such dimensions such as professional ethics are indeed very important, especially if professionalism is to be taught. And, this brings us to an all important question: "Should all engineers be trained to be professionals?" We began our overview with a fundamental timeless educational question raised by one of the greatest minds of antiquity. It is only fitting that we should answer this closing question in our overview by quoting a crucial and timely warning, boldly offered by one of the great thinkers of our times:

> "Necessary technical excellence can only be acquired by a training which is apt to damage those agencies of the mind which should direct the technical skill".
> Alfred N. Whitehead,

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