Engineering education —the long haul

by R. E. Grace

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The universities set a pattern by their curriculums for today's student. Will the future be created or extrapolated?

The trend in engineering education in the last decade has shown a flattening of the growth curve for bachelor's degrees. By comparison, there have been sharp advances in the numbers of two and four year technology graduates and of master's and doctor's graduates in engineering. The numbers of bachelor's graduates in engineering will inevitably decrease unless baccalaureate degree programs in engineering attempt to broaden their base, rather than to become more narrow and specialized. As increased importance is placed upon the master's degree by students and industry, there will be substantial increases in the proportion of master's degrees awarded within the engineering profession at large.

Several things must happen in the field of metallurgical engineering in order to provide a continuing stream of personnel into the profession. Universities must prepare a full spectrum of technical personnel. Both industry and government must be prepared to accept two and four year technology graduates as well as bachelor's, master's, and doctor's degree holders in engineering, and must

plan for effective utilization of the full spectrum of technical graduates. An increasing fraction of production control work will be handled by technical institute graduates. Engineers at the bachelor's and advanced degree levels will find greater challenges in engineering development in both production and manufacturing. The craze of the 1960's over the structure and properties of materials will diminish, and new emphasis will be placed on manufacturing methods. How to process materials, how to fabricate them, and how to make economic trade-offs between different materials and manufacturing methods will be the new goals of the materials-conscious engineer. The national economy will exert the necessary force to reshape the direction in which the profession is moving.

What are the likely limits of available manpower? One might use the number of annual B.S. graduates from metallurgical and materials curricula as a frame of reference. In the next decade or two an optimist might hope that the present figure of 1,000 B.S. degrees per year (rounded) would increase to

1,200 or 1,300; the pessimist might expect only 500 to 600 B.S. degrees per year, with a possible reduction by 50% in the number of institutions offering metallurgical and materials curricula. Based on these estimates, metallurgical engineering as a profession will continue as it is today—needed, but obscure as a career choice.

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Certainly what is not needed is a narrower curriculum approach for undergraduate engineering students. A "perfect" metallurgical curriculum is of little value if no students are enrolled in it. In fact, what may be needed is a rather complete de-emphasis of the curriculum approach to materials education.

There are important interfaces between the field of engineering materials and every other engineering discipline. A few examples are as follows:

electronic materials—electrical engineering
composite materials—civil engineering
materials production—chemical engineering
manufacturing processes—in-

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dustrial and mechanical engineering.

Students should be encouraged to couple materials education with other engineering disciplines even though, on the surface, such programs might have less depth than is found in most metallurgical curricula today. What is needed is a few materials courses, one or two of which should be taken by every engineering student in the U.S. Other materials courses should be available to follow as electives. The advantages to this are that the faculty would have exposure to more students, the students would get a broader engineering education at the B.S. level, and industry would receive increased numbers of personnel with a materials awareness.

The metallurgical community needs to give up some of its professional identity at the baccalaureate level in order to strengthen its approach to materials education for all engineers. In the long haul it will surely be better to lose some professional identity at the B.S. level if increased attention is given to materials education in all engineering curricula. A whole new wave of professional identity and eventual recognition by the general public might well follow.

There will be some who doubt this strategy. For them the guiding principle should be as follows: the university should educate students for a future not yet known—a future which needs to be created, not just extrapolated from the past.

Should scientists/engineers re-train—yes, but not for financial gain

by R. E. Cech

In recent years it has become almost axiomatic that each professional society meeting must include a seminar or panel discussion directed to the question: Should scientists/engineers retrain? And, like the famed A.M.A. seminars on childbirth that traditionally never include a mother, these discussions never seek the viewpoint of a re-trained engineer to temper the enthusiasm of the deans of engineering and the executives of industry who invariably comprise the panels. Since the net result of this avenue of career development is still highly conjectural, it behooves those of us who have embarked upon it to

communicate our observations to the community of scientists and engineers. The writer is a metallurgist and AIME member since 1948. Prior to undertaking his re-training adventure, he had completed 14 years at the bench as a technical staff member in a corporate research laboratory. Upon completion of his studies he returned to the same position at the same laboratory.

The first observation worthy of note, and one often overlooked in numerous discussions of the subject, is that a loss of mid-career earnings is enormously greater than the loss experienced by a young man who forsakes high

Fig. 1—Typical annual earnings for the experienced professional metallurgist—1960 to 1970 (expressed in constant 1960 dollars).