INDUSTRY AND THE ACADEMY: AN UNCERTAIN ALLIANCE

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In the program of the morning, from the address by Messrs. Dole and Simes you were made aware of the problems facing the United States associated with the production of energy, now and in the future. As this Energy Resource Conference moves into this afternoon and the second day the dimensions of the energy problem, called by some a crisis, will be fully delineated. Whether there is a state of crisis or not may be a question of semantics, but there is no doubt in the minds of informed observers that the problem of an adequate energy supply confronting the nation is serious indeed.

The problems facing our society have implications beyond the concern over the energy resources and the availability of fuel supplies, as important as those factors may be. There is in addition, the necessity for research and development, designing, financing, manufacturing, siting, erecting and commissioning a wide variety of power producing, energy transforming systems within the next three decades.

A specific, but not isolated, instance of the magnitude of the physical plant development necessary within the next thirty years is that of the electric utility industry, which by year 2000 is to produce about one-quarter of the total energy available for use. To do that, the electric utility industry must increase its capacity by an estimated 2.8 million megawatts, which will require an expenditure in excess of 1.4 trillion 1970 dollars, and will require 19 billion engineering and construction man-hours, exclusive of the manpower required for research, development, design and manufacture of power equipment, and the man-hours required for transmission and distribution systems.

The present combined, available work force knowledgeable of the utility industry could produce 130 million man-hours per year against the projected growth of 222 million man-hours in 1975; 590 million in 1985; and, 1,690 million by 2000. The education and training of this expanded work force to meet the manpower demand without over- or under-supply in the several categories (engineers, engineering technicians, construction personnel, etc.) requires careful planning and even more careful implementation of those plans than we have heretofore demonstrated. The electric utilities industry is just one example. Other industries will have similar demands on the resource of technical manpower.

It is the contemplation of the technical manpower resource, its creation, maintenance and effective usage that leads me into the subject I was asked to explore here today: university-industry relationships---an uncertain alliance.

As one who has spent one-half of my career in three rather different industries, and the other half in three just as different universities, I am distressed by what I perceive to be the growing divergences in interest and philosophy between the academy and industry when each has so much to offer the other; when <u>together</u> both hold much of the promise for the future of our technological society; where without either we will surely fail in our quest for future well being and progress. I believe there exists a mutual, if unfortunate disenchantment between industry and the universities, and I believe each in its own way bears a responsibility for the disenchantment---that each should endeavor to consider the situation in a serious way to heal the breach and learn to work together. It will not be easy. Industry <u>must</u> rely upon the graduates of the universities, particularly the professional schools, as the source of new personnel and new ideas, and should therefore take more than a casual interest in the educational and training programs afforded the students. The universities, again particularly the professional schools, need a close association and knowledge of the problems of industry as a source of ideas and direction, and should therefore take more than a casual interest in industry.

I believe it safe that no engineering school has ever been particularly successful without an intimate association with industry. And I would venture the observation that no industry has been long successful without continuous injection of new talent from the universities. Why then the current state of affairs? I offer some observations.

From the time of the creation of the first truly professional school of engineering in 1833 until World War II, the engineering schools were closely associated with industrial progress. During this period technical innovations came in series, with relatively long periods of development. The engineering schools with their resources of the day were able to participate in all, and to lead in many of these developments. The College of Engineering here at the University of Kentucky was known for the pioneering work of Dean F. Paul Anderson in the field of air conditioning, as well as for his students, who were instrumental, with others, in the development of the air conditioning industry. From the fascinating correspondence of that period it appears that the universities and industry were in rapport.

Because of, and following World War II, technical innovations came not in series but in parallel: aerospace, electronics, nuclear and computer technologies are examples. Not only did these developments require engineers with a more sophisticated education, they required enormous financial and physical plan resources to ensure reasonable progress.

Federal funding came into vogue and the existing equilibrium was upset.

For the first time in their history the universities had access to financial resources for research and development programs with essentially a free choice of project identification and direction. The faculties quickly developed allegiances to the several federal funding agencies, abandoning at the same time their ties to industry,except for those few industries of special interest to the federal government.

Engineering schools, reacting to the demand for graduates, expanded rapidly,becoming at the same time more diversified. Educational programs were modified correctly to include a larger component of science and mathematics, and incorrectly to eliminate courses in design and experimental laboratories. One result was the production of a more theoretically sophisticated, but probably overall less competent graduate.

Engineering faculties, comfortable with support from Federal agencies sought little and received less from industry; they sought neither experience in, nor exposure to industry. The gulf in mutual interest and understanding between industry and the university widened. The situation was improved not at all by the recent period of introspection in which the universities engaged in a search for relevance in an evolving climate of disenchantment with science and engineering. The self-studies produced little except an overall degradation of quality and reduced standards of performance. Schools of engineering, functioning under the aegis of the university proper, have elected to conform to lower standards, standards appropriate perhaps for programs in the liberal arts, but not at all for the professional schools. Over the years, much of what was the essence of engineering has disappeared from the programs of the engineering schools. Industry, the major market-place for the graduates of engineering schools, in observation of this trend, became increasingly critical of the academy, and tended to deal with the universities more at arms length.

But what of the other side of the coin? Industry differs sharply from the academy in that it is not particularly democratic, has relatively monolithic goals, and is unabashedly dedicated to making profit. Most industry is organized in a structure of profit centers, each center with responsibility for profit or loss. This very organization with the resulting preoccupation with the bottom line of the balance sheet leads to lack of concern for the more distant future, and inhibits longer range research and development. As a result, there is undertaken little research and development work of the type particularly appropriate for sharing with a university, unless absolutely necessary in support of some threatened product line. When such work is undertaken, it is on an urgent, full-time basis. The emphasis is more on timely results, and less on full phenomenological understanding -- just the opposite of the interest of the academy.

In this climate, the engineer in industry is inclined to view the engineer in the university with some reserve; and however unfairly to subscribe to ---" those who can do; those who can't teach!" The engineer in industry while perhaps unpracticed in theoretical analysis, has accumulated an enormous reservoir of experience in his respective technology. To make use of a university professor as a consultant or colleague the engineer in industry must elect to inform the consultant in his own technology, and this he is sometimes reluctant to do, even though the resulting interaction would be mutually beneficial. Even where such arrangements are made, the partial commitment and the part-time availability of the university professor for an industrial assignment is something of a frustration to his industrial counterpart.

Management in industry is even more diffident in establishing working relationships with the universities. There is always the fear of untimely disclosure of proprietary information, or the concern for loss of control over work performed under university auspices. The insistence by management on tight contractual and project control and upon restricted or delayed publication and patent rights, and the equal insistence by the universities for freedom from such constraints constitutes a major impedance to improved relationships.

One might well question whether two such different enterprises can ever be persuaded each to recognize the assets of the other, and to develop a protocol to enable them to work together for common benefit. Our technological lead in the world is being seriously eroded, with the promise of certain further erosion should we fail to reap the benefits of strong industry-university productivity.

I believe the rapport between industry and the universities can be restored and perhaps even improved, but certain accommodations will be required.

Industry must turn from an almost total preoccupation with the bottom line and short-term interests to consideration of longer term goals. Research and development programs, consistent with overall corporate long-range plans, should be formulated and implemented through joint efforts of industrial and university personnel. Rather more planning is necessary to use effectively university personnel and facilities, but that very planning can ensure mutually satisfactory project management and control. Relatively longer term commitment for program support could help ease the problem of work schedules for university personnel. An appropriate research and development program, effectively carried out, can ensure future profitability for industry and a wealth of experience for the university.

Research and development programs including university participation should be budgetted as a continuing part of the cost of business, subject to periodic review

naturally, but a regular and substantial commitment by industry.

The universities, particularly the engineering schools, have perhaps a more difficult accommodation to make. Assuming support from industry on more than the present token basis, the engineering schools incur an obligation to use the support effectively.

Utilization of industrial support might best occur if the schools of engineering were reorganized as professional activities rather than to the traditional but less appropriate activities of the university. The organization of the engineering schools must permit, indeed encourage, the acceptance of complex engineering projects which can be successfully undertaken by a coordinated, cooperative group of faculty and students. The university administration must acknowledge the validity of this kind of professional activity in the engineering schools. Faculty and students participating in these industrially supported programs of professional importance need to have assurance that they will be rewarded, or at least not penalized for their participation.

To assure closer ties with industry, it might be wise for the engineering schools to replace the traditional, and poorly used sabbatical year, with a more frequent fifth year in industry. Between term consulting arrangements would provide continuity to the program as well as financial incentives to the faculty members involved.

Finally, the universities should remove the present requirements that most degree work must be accomplished in residence, on campus, to permit the use of industrial facilities which are in some cases superior to those of the universities.

On an optimistic note, I detect recently a growing awareness on the part of both the universities and industry of the serious consequences of continued noninteraction.

A series of regional conferences within the past year or so, brought together key personnel from both industry and the universities in search of ways to ensure effective industry-university relations. And while the results from these conferences has thus far produced little, the effort was certainly a step in the right direction.

Perhaps if together the universities and industry really put their minds to it and their hearts in it the "un-" can be removed from the "uncertain alliance."