

Chemical Engineering and Society

So much has been said and written recently about the public image of engineering and about the problems of poor recruitment to science and applied science that there may seem little that can be usefully added. There are, nonetheless, aspects of this problem which seem to me to have received too little attention.

At the joint conference on chemical engineering in London last year a session* on chemical engineering education considered What Industry Looks for in Its Chemical Engineers, but there was no paper on what society looks for in its chemical engineers. Both industry and the public need more engineers, chemical and other, but the initiative and power to meet this need are now partly in the hands of the young people of our nations. If they look at engineering as a possible career and reject it, it is up to us in the engineering profession to find out why and to do something about it. It may be too much to expect potential engineering undergraduates to write a rival paper on what they look for in industry, but they will have considered this; young people nowadays, as they always have been, are highly idealistic, and they will have thought much about what they look for in life and about the society that has bred them. If they do not like the look of engineering, little will be achieved by burnishing its "public image" for them: they can see the real thing for themselves. Whatever they read about the best engineering, they have only to look around them to be aware of the great gulf that exists between this glittering picture and the everyday practical reality. What will impress them will be the secondary effects of the technological revolution which has produced our material prosperity: the smoke and grime; the poor habitations; the countryside obliterated by mine workings; the canals and rivers and atmosphere polluted; the skyline dominated by vast naked pieces of plant for producing chemicals, fuel, or electric power, whose great shapes—though pleasing to some through their sheer functionality—may permanently disfigure and transform neighborhoods both physically and socially.

* Session 8 of the Joint Meeting between the American Institute of Chemical Engineers and the Institution of Chemical Engineers, June 13-17, 1965, in London.

When our young critics look at this discrepancy, may they not have some justification in thinking that it is Engineering that has got to be altered, not merely its public image? Moreover, it will cut little ice with them that certain sections of the chemical industry take very seriously the problems of siting and of designing a plant to blend harmoniously with the environment; industry as a whole can hardly make this claim. And they may suspect that, in any case, this concern with environment applies only to items that are so large that they attract public attention and legislation.

But why blame the engineer? Hosts of others share the responsibility for creating socially indefensible industrial conditions. It's the boards of directors that control the purse strings, and surely it's up to the politicians to look after the interactions between the different sections of society as a whole? This may be so. But if we engineers accept only the economic boundary conditions of the problems we try to solve—if we are going to argue that it is someone else's business what happens to society as a result of the technological power that we wield, then we are open to the charge that we are technicians and not a profession. Yet if it is our business professionally, then we must recognize it as such and train our engineers accordingly, just as architects do.

And if the architect appears to be in a different category, why is this? It is simply that the architect is recognized as having a trained judgment in aesthetic matters, whereas the engineer is expected to confine himself to "technical" considerations? Possibly. But this is only one facet of a larger and more significant fact: the architects' creations are recognized as having direct relevance to society's needs. Civil engineering, perhaps because of its antiquity, is similarly recognized; it is taken for granted that when we build, for example, a bridge we do not erect the cheapest possible structure. But a much more purely commercial set of criteria applies when we erect, say, a group of chemical factories—an organization which may employ many thousands of workers, which may alter the whole appearance of a large town, which may perhaps cut the foundations away from some other industry, and which may inject a

new material into other manufacturing industries and into millions of homes. This, surely, is creating something which has the most far-reaching impact on society.

If the need for a change in attitude is conceded, two complementary lines of action suggest themselves, for we have to tackle both ends of this relationship between Engineering and Society. Engineers must individually accept more responsibility for the social implications of their work: society must recognize its dependence on engineering and ask more of the engineer.

Concerning the engineer himself, we have a special opportunity while he is being educated. At the university or college we have the chance to foster his ethical and social values, or to suppress them; the attitudes we encourage at this impressionable age can have a deep-seated and lasting effect. It is the educator's task to prepare the students for life, not just for industry, and we are in danger of going too far in our practice of encouraging the commercial and economic standards of industry to permeate the chemical engineering courses that we run. If this seems heretical, let us not lose sight of those thousands of potential first-class engineers who have rejected engineering and chosen other professions.

Are these social matters teachable subjects? In his training, the student is taught to produce optimal solutions to his problems, and in doing so he learns to work within various boundary conditions, most of which are sharply definable in numerical terms, but many of which are matters of "experience and judgment." Typical of the latter is safety—safety of the operator and of the public. However far the engineer goes in his technical and probability calculations and in his attempts to allot an economic value to safety considerations, he is forced to make his final assessment in the light of human behavior. Recognizing this, we attempt to give him some pertinent guidance during his education: we try to give him appropriate habits of thought and the necessary techniques for handling such problems. The same guidance applies to the techniques of handling

management problems, that other society-based discipline which used to be regarded as unteachable. In a sense, the fostering of social awareness is an extension of the basic ideas of management beyond the boundaries of the factory fence. At the very least, the student can be taught something of the likely social consequences of his activities as an engineer: he can even learn something of aesthetic judgment—sufficient perhaps to open his eyes to the subject and help him to discuss its implications with others. No doubt, the young engineer going out into industry as a subordinate in a team would be laughed at, or worse, if he freely aired this aspect of what he had been taught, but before very long he and others like him will have assumed posts of responsibility, and from then on this policy can bear fruit.

Turning now to the other half of our problem, Society's response to Engineering, we return in a sense to the public image of engineering after all. However, we must cease saying to the public, "Look at the wonderful achievements of engineering! Learn to be an engineer and experience the excitement and satisfaction of taking part in a forward-looking enterprise" instead we must stimulate public discussion and public *criticism* of engineering; we must incite intolerance of bad engineering; we must make the public aware that it has hardly a possession, hardly a pursuit which does not depend overwhelmingly on the products of engineering. We must show the best that engineering can produce and expose the gulf that lies between this and what the layman has come to accept as normal. And let the public conclude that in its own interest it must demand *better* engineering—technically better and better integrated with society's wider needs—so that a climate of opinion can grow in which it becomes obvious that engineering is the field toward which the most gifted and most versatile will naturally migrate.

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