SHOULD ENGINEERING STUDENTS BE TAUGHT TO BLOW THE WHISTLE ON INDUSTRY?*

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THE QUESTION to be answered is not only **should** an engineer blow the whistle on industry but whether students of engineering should be **taught** to do so. This leads to the broad question of whether moral or ethical standards of any kind should be **taught** to engineering students. Our answer is that we consider our students to be free individuals who must ultimately make their own choices based on their own sense of values. The teacher cannot play God; he cannot program them with a list of rules or a set of absolutes. What he **can** do, however, is to assist them in seeing the alternatives and to familarize them with the way others have approached moral problems. The teacher can tell them how **he** might act in a given situation and he can make them conscious and aware of the **consequences** of moral decisions (or indecisions) but he should not and cannot make the decisions for them.

However, in order to give the student a basis for making his moral decisions we would present for his consideration the following hierarchy of moral values that have been proposed by the philosopher Robert Hartman:

1) **Extrinsic values:** These are basically material values, e.g. the monetary value of an automobile, a house, a boat, a heat exchanger, or of any material thing.
2) **Systemic values:** These deal with systems or organizations. Loyalty to an organization such as one's employer, to a fraternity, to a school, to a profession, to a department in a university, to one's country, or to a political system are systemic values.

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3) **Intrinsic values:** These might also be called human or spiritual values. They include the idea of the infinite worth and dignity of a human being. Intrinsic values cannot be measured in terms of dollars and cents. The highest of these values is that of an individual human life.

While systemic values are rated higher than extrinsic values, they are superseded by intrinsic values. Everything in the world, including the world itself, can be valued extrinsically, systemically, or intrinsically. For example, a button can be valued systemically as the product of a button factory, extrinsically as a useful part of a shirt, and intrinsically as an object to which a fetishist is devoted.

An engineering student can be valued systemically as another graduate or "product" of a department, extrinsically in comparison with other engineering students, and intrinsically in his own uniqueness as a human being.

Let us now apply these to some possible cases in which the engineer must make a moral decision. In each case we will presume that the financial welfare of the company is in jeopardy and that the engineer subscribes to the above hierarchy of values.

Case I: The company is releasing substances or manufactures a product that will **undoubtedly** result in death or serious injury; e.g. a **botulism**-causing bacteria in a canned good or the release of fluorides into the atmosphere. The engineer **must** "blow the whistle" because human life, an intrinsic value, is more important than the good of the company, a systemic value.

Case II: The company releases substances or manufactures a product that **may** result in death or serious injury. For example, his company is making flammable children's pajamas or labeling a combustible urethane foam as non-combustible. In this case the engineer must first decide whether a high probability of human death or injury actually does exist under the likely conditions of use. We feel that if such a risk is real he would be justified in informing consumer and governmental groups of the potential danger—assuming that he has done everything in his power to convince management of the problem.

Case III: The company is making a product that is to be used in a conflict that the engineer considers to be an "unjust" war. In this case the engineer should resign if his personal conscience tells him that he cannot work for a company that makes such a product. However, if there is a legitimate difference of opinion as to whether a war is or is not just, he should be cautious about inflicting his own moral concepts on others by publicly "blowing the whistle." On the other hand he might recall that Adolf Eichman, who burned thousands of Jews in ovens during World War II, claimed he was innocent because he was merely following orders and acting as a "transportation system". This is a good example of placing systemic values—presumably loyalty to the country —ahead of intrinsic values. The chemists and engineers who worked for the Krupp works in Nazi Germany undoubtedly also felt that their responsibility was only to the company and to their country.

Case IV: The company is releasing pollutants that the engineer **thinks** are deletrious to the environment, but which are not directly dangerous to humans. In this case, the company is probably, under today's legal atmosphere, already taking steps to eliminate the problem. If so, the engineer should work within the company to accelerate the process. He should balance the good he can do in that manner against the good and harm he might do by "blowing the whistle". In this case both the good of the environment and the financial welfare of the company can be viewed intrinsically in terms of their effects on people. In the name of human values the environment must be protected, but also, in the name of human values, the role of the company in manufacturing a useful product and in providing employment to the community must be considered. Here each case must be decided separately, but loyalty to the company should not require them to defend a company that repeatedly despoils the environment.

Case V: The company is selling a product that is useless but is known to be harmless; e.g. a battery or crankcase additive, or an ineffective but harmless patent medicine. In this case he should honestly inform management of the results of any tests that he had made. If the product is then falsely advertised, he should leave the company.

TWO SIDES OF THE COIN

We feel therefore that the engineer today should be aware that there are really two elements of the question of blowing the whistle on industry: One is the attempt to do it internally, to influence management in ways that are both beneficial to the company but which still satisfy the moral integrity of the engineer as he views himself and as he views his job in reference to the company and to the society about him. The second is to do something externally. We feel that this should be done if the first approach fails. Of course some may argue that the engineer who tries to accomplish change of this type internally is doomed to failure. While this may have been true in the past, we feel that the young

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engineer who is leaving the university and entering industry today has a great opportunity, if he so wishes, to have an impact on the decision and management processes of his company. One possible reason for this increased influence is the teetering balance in which the companies find themselves between the problems of continued profitability and the pressure of (a) maintaining safety standards for OSHA, (b) in meeting pollution standards as prescribed by EPA, and (c) in meeting the demands of equal employment and non-discrimination as required by various federal laws and as expedited by the Department of Health, Education, and Welfare. From our point of view, one of our important jobs in education is to inform the engineer of his position of making his influence felt and known in the organization that he is joining.

We also think that at this time efforts in the direction of being immediately involved can have definite results. The trend in many management schemes is to try to drop the decision making process to the lowest possible level. One company (as we have been informed recently) is involved in such a program in which the lowest level of either management (or maybe non-management; i.e. the actual operating personnel) will make the decisions which they can make. They can influence their job each day and possibly even influence more than themselves; they may influence the organization in which they are working. In the experience of one of us at Los Alamos Scientific Laboratory, the decision making process was very much centered in the so-called staff member. He was not a member of management as such but actually the ideas for projects, the direction that projects were to proceed came in most cases from the staff member. We hope that our students will go out into the industry with the idea that they are a member of the management team and that they can contribute directly to the decision-making processes going on.

THE 9 TO 5 MAN

IN THIS DISCUSSION we have been influenced to a great extent by the book, **The Greening of America** by Reich. Many of his descriptions of human nature, of the types of Consciousness I, II, and III, from our own experience, are extremely accurate. These descriptions illustrate how most engineers perhaps have behaved in the past and how they possibly might behave in the future. A good number of engineers are members of the Consciousness II group as described by Reich. This group is one that believes in large organizations, large structured groups. A Consciousness II engineer would believe that the decisions made by the organization are not to be challenged. He should go ahead and blindly do as he is told to do and don't worry about it. The attitude is: "Do your job; get your 40 hours a week in; and then forget about it. Let's get home, let's get to the beach, let's do our thing on the weekend, let's live a bifurcated life, a life which involves fun and family on one hand and the almost forced involvement with a company on the other."

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If we educate students to go out into industry with the idea that this is the only possible point of view, we are making a great mistake. We are not priming our students or engineers to be the effective persons that they can be in industry.

With this view in mind we are teaching a seminar course at the University of Florida to seniors in which we are using **The Greening of America** and **Man, The Manipulator** by Shoestrum as texts to look at the various stances that we as engineers can take. The question we've asked them is: "Can we take stances other than the classical one?" The classical one is being a member of Group II Consciousness. Is there a possibility of integrating some of the ideas of Group III consciousness into our engineering profession and into our ideas of achievement and still be strongly productive and interactive? In **Man, The Manipulator,** Shostrum describes the manipulative forms that many of us find ourselves trapped in but also describes the thrilling description of the actualized person: the person who really can be interactive, can be open, can express his feelings, can share and be intimately involved in the sharing and feedback process. Our hope is that our engineers can take on some of these actualized concepts.

THE ACTUALIZED CONTRIBUTOR

A PERSON CERTAINLY HAS to have some of the concepts or elements of the actualized person to immediately contribute towards an organization. He must take risks. He must speak up. He must involve himself in a productive way with all the decisions in which he has contact. He has the difficulty of doing this in a way which is acceptable to the people around him. He cannot be overbearing; he makes no points that way. But he cannot be under-aggressive; he again makes no points. So, therefore, the process is one of sensing where the other human being is, being aware of where his managers are and of their capabilities and maybe lack of capabilities.

Therefore, our stance today is that our students **can** blow the whistle on industry, either internally or externally. But he can do it by being a productive management team, even when we're not so designated. Our responsibility as educators is to set them up, to make them aware that this is their responsibility. We find it very difficult to preach morals or to teach a definite set of ethics. But we feel that each person should be encouraged to express the set of ethics that he personally has developed. We do hope that our engineers can go out and be actualized people, be non-manipulative, be open. They can express their concern about what the company is doing, about its processes, about the pollution capability, about the discrimination practices that they see, about the quality or lack of quality of their product. These are of direct concern to every technical person who works with a company, and the first step, the most productive step, is one of immediately being interactive.

"Had I but served my God with the zeal that I have served my king, He would not, in my old age, have left me naked before my enemies!"—William Shakespeare

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ChE book reviews

Modeling Crystal Growth Rate from Solution
By Makoto Ohara and Robert C. Reid
Prentice-Hall (1973), 272 pp.

Reviewed by Maurice Larson, Iowa State U.

This book is a good summary of the most popular theories attempting to describe the mechanism of crystal growth from solution. Of its 272 pages, 134 pages are devoted to appendices. It is printed by photo-offset of the typed manuscript. It is well organized and readable, but many of the illustrations do not have figure numbers nor titles. This leads to some difficulty. The index is adequate but brief.

The seven chapters of the non-appendix portion of the book are devoted to a Synopsis of the text, four chapters describing four growth mechanism concepts, one chapter concerned with impurity effects and a chapter which compares recent experimental data with theory.

The Synopsis summarizes the book well, points out what the purpose of the book is and briefly states the concepts of the various mechanistic models for growth. Chapter 2 discusses the classical surface nucleation theories of growth and shows that they are perhaps quite inadequate to explain observed growth rates. Chapter 3 discusses crystal growth limited by mass transfer, introduces the Burton, Caberra, Frank bulk diffusion model and treats it in detail. Chapter 4 discusses surface diffusion theories, again calling on the work of Burton, Caberra and Frank. The chapter is quite short leaving the detailed mathematical development for Appendix A which is 68 pages long. The treatment is detailed and lucid. Layer and dislocation growth concepts are adequately treated.

Chapter 5 attempts to account for the appearance of microscopic growth layers and distinguishes them from the layer and dislocation growth theories of Burton, Caberra and Frank. Impurity effects are briefly treated in chapter 6. The treatment reflects the general lack of adequate theories which explain observed phenomena. Finally chapter 7 presents data which can be explained to some degree by the theories presented previously.

The book is largely concerned with the detailed mathematical presentation of existing theories and the correction of some derivation errors found in the literature. In the words of the authors 'the book has solved no *new* (italics mine) problem' but the treatment should be helpful for those wishing to gain an understanding of present thought without extensive literature review. It will be a good reference book for those new to the field and could provide a substantial part of text material for a course in crystallization technology.