"Today We Will Hear From The ChE Department"

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Once a year each engineering department at N. C. State gets a 15 minute shot at the freshmen, in which a faculty representative attempts to convince them that they would make a tragic mistake not to enroll in his department's curriculum. Several years ago, we came to the unoriginal and inescapable conclusion that boring the pants off someone is not the most effective way to convince him of anything. Coupling this conclusion with the firm belief that chemical engineering is at least as good as any other curriculum and career choice for most engineering students, we evolved The Lecture, which is given below for those who wish to pick up some of the ideas it presents, or to suggest others.

Several points are worthy of mention before the lecture commences. Two years ago, the time allotted for the departmental presentation was 50 minutes. One year ago, the time was cut to 15 minutes. Somehow or other, the same lecture has been found suitable for both time periods; the 15 minute version merely requires a slightly faster delivery, fewer side comments, and shorter pauses for laughs and breath. Many of the ideas in The Lecture were lifted from a talk given by Professor Harold Hopfenberg of our Department. Finally, in each of the past two years, the number of freshmen who chose chemical engineering at year's end was three to four time greater than the tentative (pre-Lecture) preregistration enrollment. Our rigorous background in the scientific method prohibits our drawing any causal inferences from this data; nonetheless . . . .

THE LECTURE

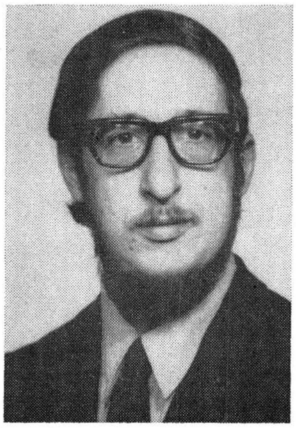
The usual lecture entitled "What is Chemical Engineering" is a collection of boring generalities and information which no one at your stage of the game could possibly care about. For instance,

> Chemical Engineering is an important and interesting field, in which the basic principles and techniques of chemistry, physics and mathematics are applied to industrial chemical manufacturing and processing. Here at State we have a fine department and well-rounded curriculum, which is designed to provide sufficient preparation for either an industrial career or further study in graduate school. The Chemical Engineering curriculum begins in the sophomore year with a course in basic stoichiometry, and continues with . . . . We on the faculty are eager to help you in any way we can—feel free to call on any of us at any time. Now, my first slide shows a cutaway view of a typical bubble cap distillation tower, which is a device to . . .

and so on for 45 minutes in the same sparkling vein.

Most of these things are true, but all of them are pretty much irrelevant to someone trying to make a career choice for himself. Chemical engineering is important, but so are lots of other fields. We think our department is good, but we're not the only good department in the school. Some of us are very useful people for you to meet now, knowledgeable about prerequisites and career objectives and things like that, while others of us wouldn't begin to know what to do with you if you suddenly materialized in our offices. And if we told you, for example, than in your sixth semester as a potential chemical engineer you would be required to take a course in thermodynamics, your proper reply would be "So what?"

"The lecture"— North Carolina State's "15 minute Shot at the freshmen."



Richard M. Felder did his undergraduate work at the City College of New York, and obtained his PhD ('66) at Princeton. He spent a year at A.E.R.E. Harwell, England, on a NATO Postdoctoral Fellowship, followed by two years at Brookhaven National Laboratory, and came to North Carolina State in 1969. Professor Felder's research in graduate school and immediately thereafter concerned the physics and chemistry of hot atoms; more recently, he has become involved with photo-chemical reactor analysis, radioisotope applications, and applications of engineering technology to medical and environmental problems. He has served as an industrial consultant on artificial organ development, and as a consultant to the government of Brazil on industrial applications of radioisotopes.

What should we be telling you then? It might help to tell you exactly what chemical engineering is, or what you would most likely do for a living as a chemical engineer. The problem is that we really don't have a good definition of chemical engineering, and we have no idea at all what you would end up doing as a chemical engineer. If you pressed the point, we might ask what kinds of things you would like to do, and when you told us we would say that they're probably what you'll be doing if you still feel the same way in four years, which you probably won't.

Incidentally, questions like "What do chemical (and civil and mechanical and electrical) engineers do" are precisely the kind of questions you should be asking now, and probably aren't. According to our unofficial statistics, 1% of you are in engineering school because you studied the alternatives and concluded that you were born to be engineers, 13% are here because your fathers or somebody had the idea that you should be engineers, 23% because someone told you that engineers earn more money than anyone else, and the remaining 63% because English and history are a drag and pure science and math are too hard, so what else is there?

You're going to keep doing the same thing, too, if past history is any guide. "I don't like Chemistry 101—I'd better not go into chemical engineering." "Physics 205 is too tough—better forget engineering mechanics and electrical engineering." Eventually you back into one field or another, go through four years, get a job and maybe then realize that while there's nothing about your job that you hate, there's nothing much to like about it, either, and that what you'd really like to be doing is . . . . Unfortunately, by then it's usually too late: one man in a hundred is sufficiently motivated to switch fields completely after he gets out of college. The time to start thinking about what you'd like to do is now, and if you make your decisions on the basis of how you like one or another of your freshman courses, you're blowing it, and you deserve whatever you get. (Incidentally, Chemistry 101 has almost nothing to do with chemical engineering.)

All right, what do you want to do? You don't know, probably, Let's throw out a few suggestions, then—call it games chemical engineers play.

THINKING ABOUT GOVERNMENT WORK?

Become a chemical engineer and join the CIA, and diagnose aerial reconnaissance photos of chemical plant facilities in Russia or China or whoever the bad guys are at the moment, or talk to visiting bad guy chemical engineers and subtly extract useful information from them.

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INTERESTED IN THE HUMAN BODY?

Become a chemical engineer, specializing in biomedical applications. Things like the heart, lungs, kidneys, and blood circulation are biological analogs of the kinds of things chemical engineers have always dealt with and chemical engineers have consequently been among the leaders in the development of artificial organs and physiological systems. The application of engineering principles to the design of a device to remove wastes from blood when the kidneys fail, for example, is something for which a chemical engineer is trained and a physician is not.

ENVIRONMENTAL PROBLEMS CONCERN YOU?

There are several ways to attack the problem of a pollutant being released into the air, or into a river or lake. You can (a) treat the pollutant in some way to make it less offensive (a chemical reaction approach), or (b) separate the pollutant from the harmless stuff it's being carried along with, and dispose of it separately in a nonpolluting way (a material separation approach), or (c) arrange conditions so that the pollutant is dispersed in such a way that its harmfulness is eliminated or minimized (a transport phenomenological approach). Several branches of engineering deal with one or another of the techniques needs to implement these approaches; chemical engineering deals with all of them.

HOW ABOUT NAPALM PRODUCTION, AND SUCH THINGS?

You can go either way. If you think that this is the kind of thing you'd like to do, then go to work for the company that does it and do it; if you don't think much of the idea, tell that company exactly why you have no intention of working for them. (Talk about your effective protests!)

MANAGEMENT, FINANCE, LAW?

Become a chemical engineer, and move into production, research, or design supervision, or go to work for a firm that specializes in chemical industry venture appraisal, or go into patent law.

SCIENCE AND MATHEMATICS?

Some chemical engineers are indistinguishable from pure scientists and applied mathematicians, except that the engineers are a little more likely to wonder occasionally about the short range applicability of whatever they're doing.

LAST, BUT

far from least, you can go to work in one of many capacities within the chemical (or petroleum or plastics or pulp and paper or textile) industry, which is what all chemical engineers used to do and most still do, although there are many excellent chemical engineers who become ill within 20 miles of a chemical plant, downwind at any rate.

Notice the variety of possibilities just listed, and the list is by no means exhaustive. Also notice the responsibility—you decide for yourself whether to make napalm or artificial kidneys!

Since, as we have indicated, most chemical engineers end up in industry, it might be instructive to consider industrial chemical engineering games in greater detail. It all starts in a laboratory, when an enterprising research and development engineer discovery a reaction that gives you something valuable from something not as valuable. Let's say our man discovers that if you combine a grain, say corn, a sugar, and a bacterial agent, say yeast, a reaction called fermentation occurs, and if you boil the resulting mixture in a device known as a distillation column, or still, the part that comes off as a vapor and is then condensed has some very interesting properties.

Next comes an engineer who lays out a stepwise procedure for carrying out the new process on a large scale. He might propose something like taking the corn, sugar and yeast, and allowing them to ferment in a tank for 7 to 14 days; the tank should be buried in a field or located well back in the woods, since the reaction is easily disturbed by outside agents. The wet mash is then put through a separation unit, the liquid skimmed off the top is boiled in a still, and the vapor is condensed in a cooling coil. The liquid that comes out is known as the raw product, which is no exaggeration at all. The product may be sold as

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it is, or subjected to an adsorption step on charcoal beds to increase its purity, so that it may be sold at a higher price. The creative process engineer also notes that the economics of the process may be improved by taking the mash residue and selling it as hog feed instead of throwing it away.

This is an excellent example of a chemical engineering problem. You have to deal with the movement of material from one unit to another (fluid flow), supplying heat to a still (heat transfer), chemical reactions (unit processes), separation processes, such as skimming, distillation, and adsorption (unit operations), quality control, economics, etc. This is not to say that someone who isn't a chemical engineer can't do things like this—it's just much easier if you are one. The same applies to everything else mentioned here: a chemist or a physician who is particularly ambitious may be able to teach himself enough to be able to design a heart-lung device, but the things he would need to know are the things chemical engineers are taught as a matter of course.

Returning to the process, another chemical engineer calculates the size and construction materials of the process units and pipes in the system, and estimates the costs; another trained in market analysis determines whether or not it will pay to do the whole thing; another engineer lays out the plant and supervises its construction; another supervises the plant operation and sees to it that his product meets his customers' requirements; another sells the product (which may also be process equipment or instrumentation), and still another runs the show and becomes rich. Finally, some who are unsuited to any of these functions go into teaching chemical engineering.

Again, consider the variety of occupations, some of which we haven't yet mentioned: chemistry, mathematics, biology, medicine, spying, pollution control, industrial research, academic research, law, banking, weapons development, automation, economics, teaching, inventing, building, producing, selling, supervising people who invent, build, produce and sell, experimentation, theory, and on into the night. If any of these things appeals to you, you might consider chemical engineering as a career, and equally important, if you're still not sure which way you want to go, there's no better field than chemical engineering for keeping your options open. □