

feeling useful; I like to free time for others to do what they want to do. And there's enough of the competitor in me that I don't mind working at being successful. Each of my jobs calls on different talents, responses, parts of temperament, and combinations of whatever abilities I have. And each makes vulnerable different kinds of shortcomings. Research demands analytical thought processes plus whatever creativity I have, and that rather severely exposes the limits of my intellect. Supervision of personnel and administration in general require exercising judgment on problems dominated by values and the ramifications of human personality. I often find myself failing in these situations—either because I try to find an exact answer to a diffuse problem or, at the other extreme, I compromise in making a difficult decision because I give in to a desire to be liberal or compassionate.”

Administrative work is harder than either teaching or research as far as Neal is concerned—a fact which, he thinks, may reflect his lack of training in its techniques. The problem boils down to persuading other people to do things for him, and he attacks it by assuming that the people he deals with are reasonable individuals.

Like many another Caltech professor, Neal often takes a loaded briefcase home. Even when he leaves his work at the office, he finds it hard to take a real break from his duties unless his family can lure him out of town—preferably to the mountains or the beach. He feels that he is overdue for a leave of absence for about six months at another university. Such breaks in routine lend perspective. But he expects the experience will just confirm his conviction that Caltech really is an outstanding place.

He has been investing in that conviction for a long time. As an undergraduate Neal Pings was a member of the Beavers, the Board of Control, the Interhouse Committee, Throop Club, and—with real devotion—the varsity football team. All this adds up to top-notch credentials for his election to the board of directors of the Alumni Association. He took on this three-year job in 1970 not only because he was interested but because he had a two-way feeling of responsibility. He believes the faculty hasn't made adequate use of the talents of the alumni, and that the alumni could do a lot more for Caltech. As a man with a foot in each camp, he thinks he may be able to improve communications between the two groups.

If Neal's services as vice chairman of Pasadena's Community Redevelopment Agency seem tangential to the academic circle in which he usually operates, the appearance is only superficial. He's not there as an official representative of Caltech, but he points out: "I'm concerned that 20 years from now Caltech will be located in a city where it's still pleasant to live and to send children to school. The decisions that are being made right now will affect that. Faculty members here have always been involved in national affairs, but local involvement is just as important. Caltech can't isolate itself from Pasadena, and maybe I can be a bridge.”

Not even the FBI could find anything wrong with that.

## ChE book reviews

*Introduction to Chemical Engineering Analysis*, T. W. F. Russell and M. M. Denn, 502 pp., John Wiley and Sons, Inc., New York, 1972

Do not be misled by the title of the book: this is not just another textbook for an introductory stoichiometry course. The fundamental approach is that of an integrated view of the entire typical chemical engineering curriculum. The authors have decided that it is time to use something other than furnaces and sulfuric acid plants to form the background for such an introductory course. Their choice is the fluid-filled vessel, in many of its ramifications. Real chemistry is used throughout.

Those familiar with the structure of the chemical engineering curriculum will find that there are several mini-texts included here. Kinetics, design, extraction, reactors, energy balances, process dynamics, and mixing are all present. The introduction does a good job of intriguing the student, and the second and third chapters form a reasonable introduction to modeling principles. There is also a chapter on data analysis in the midst of other topics.

The first law of thermo-energy balances is covered well. There are accompanying mini-texts on convective heat transfer, non-isothermal reactors, and gas behavior.

Perhaps of more interest to the potential user is what is *not* in this book. There is no separate treatment of material balance principles.

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does not rise as high as it would if the conversion were perfect. As we proceed out the pipe, we see two conflicting effects producing the hump-shaped distribution:

1. The increasing efficiency of the "turning vanes" as the velocity falls leads to higher rise; and

2. As the angle through which the fluid must turn to exit decreases, the fluid exits more nearly horizontally and thus does not rise as high.

### A VARIATION

For graduate courses, one may insert a 5/16" thin-wall tubing about 10" long, open at both ends, into the pipe in place of the rod. In this case the flow through the tube will be great enough that the two end jets will both rise higher than the ones in the middle. This presents an analysis problem suitable for graduate students.

### SOME PRACTICAL CONSIDERATIONS

1. The pipe connections should be finger tight. A small leak doesn't hurt.

2. In placing the copper tubes in the holes in part No. 3, little care is needed to align them. After they have been soft-soldered in place, they can be easily bent into line by holding the pipe in a vise, inserting a steel rod in each tube, and tapping it gently into line with a hammer.

3. To make the pipe without the tubes (part No. 2), use extreme care to get the holes in one axial line.

4. While running the experiments, tilt the plane of the orifices a few degrees to one side (by rotating the pipe) so that the jets fall free of the pipe and do not interfere with each other.

5. Check the apparatus carefully for burrs. They can have a pronounced influence.

6. In running the first part of the experiment, it is well to show that the result is independent of which end of the pipe is inserted in the can. As long as all the connections are finger tight, the instructor can reverse the position of the pipe in the can quite quickly.

7. Allow adequate time to make up methocel solution. Sugar solutions could be substituted, but they are messy. Any viscous solution will do, but methocel is probably the cheapest and easiest.

### ACKNOWLEDGMENT

This device was used by Dr. J. Q. Cope, former vice president of the Chevron Chemical Corporation, to teach young engineers several important lessons. His procedure was:

1. Describe the apparatus to the new engineer, without mentioning the insertable rod.

2. Ask him from which end of the pipe the jet will squirt highest.

3. When he answers, goad him into betting that he is right.

4. Go get the device, inserting the rod if necessary.

5. Demonstrate—and take his money.

The educational qualities of this procedure are obvious.

### NOMENCLATURE

D	diameter	ft
f	Fanning friction factor.	
F	lost work per pound due to friction	ft-lbf/lbm
g	acceleration of gravity	ft/sec <sup>2</sup>
L	length	ft
m	mass	lbm
P	pressure	lbf/in <sup>2</sup>
V	velocity	ft/sec
W	pump work	ft-lbf
z	elevation	ft
ε	absolute roughness	ft
ρ	density	lbm/ft <sup>3</sup>

### REFERENCES

1. Perry, J. H., et al. *Chemical Engineers' Handbook* (4th Ed.; McGraw-Hill, 1963), p. 5-19 et seq.
2. Acrivos, A., B. D. Babcock, and R. L. Pigford, "Flow Distributions in Manifolds," *Chem. Eng. Science*. 10 (1959), pp. 112-124.

### BOOK REVIEW: (Continued from p. 110)

Atom balances, purge and recycle are not discussed. Although reactors form a central theme; conversion, yield and extent of reaction are not used or defined. The enumeration of the number of equations (mass balances, mass fraction constraints) does not appear, for this text does not deal with multi-unit processes in multicomponent systems.

The mathematical content is such that a student should have finished calculus and differential equations. Parenthetically, the student is asked to deal with a large amount of notation to appreciate the content. Computer methods are not stressed, although there is material on numerical methods. Any computer applications would require a supplementary text. Linear algebra, which some people refer to as "the language of stoichiometry," is not used.

In short, one must compliment the authors on their attempt to inject vitality and meaning into the first text in chemical engineering. However, their approach does not fit well in a so-called "standard" core curriculum. Perhaps our curricula will adapt: I for one concur with their philosophy. For the present, the book will find use in peripheral ways, such as refresher courses.

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