THE VIEW THROUGH THE DOORS*

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One of my favorite leisure-time activities is to walk down the hall and listen to classes in progress, hoping to get some teaching tips. I've got some time this morning—come along with me and let's see what we can pick up.

There's Professor Frobish—he's got the junior fluids course this semester.

Frobish: "...and on Monday we saw that if you write the coupled partial differential equations of change for this pseudoplastic fluid flowing in a cloverleaf–shaped channel and impose the usual singular perturbation theory boundary conditions you can easily prove that the liquid will emerge at the outlet as long as the pipe is tilted downward."

Student: "Professor Frobish."

Frobish: "That result by itself is of course only mildly interesting but Monday was the first day of class and I wanted to start slowly. Now today we'll see what happens if we relax some of those simplifying assumptions. Suppose, for example, we say that instead of a pseudoplastic fluid we have a virial gas moving at sonic velocity and the channel is made of expandable rubber and is mounted on a satellite in a decaying orbit. Now if we invoke a six–dimensional stress tensor we can easily see that..."

Student: "Professor Frobish!"

Frobish: "What is it already?"

Student: "You never finished the proof you were doing Monday and I didn't understand any of it as far as you got."

Frobish: "Finishing it was an exercise for the class...the mathematics is completely straightforward...but if you need help you'll find something similar in that paper by Lundquist I cited."

Student (a trace of hysteria entering his voice): "But I can't read Swedish."

Oh well, that will probably go on for awhile so let's move on. Good man, Frobish, although some of the faculty feel that he's too applied—they want more fundamentals in the curriculum. Look in there now...see the guy with the mustache and the tee shirt that says "Chemical Engineers Do It in Fluidized Beds"? That's Greg Furze—he teaches kinetics and gets consistently high ratings. Seems to be some action in there—let's check it out.

Furze: "Ok, guys...get the chairs in a circle and let's get down to it. You people there are A molecules, got it, and you over there are B's. A's—put on your little hats so we'll all know which

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species you are. Good. Now, when I yell *START UP* you all get going, ok, and Angie there will keep count."

Student: "Hey, Greg, I forget what we're supposed to do."

Furze: "No sweat, Joe...this is tough stuff—I don't expect you to get it right away. When I yell you all start milling around inside the chairs...move in straight lines until you bump into someone else. If it's your species, you just bounce off and keep going. If it's the opposite species you roll a die, and if you throw a 1 then you yell out *REACTION* and sit down. Got it?"

Student: "Why are we doing this again?"

Furze: "Great question, Amy. We're demonstrating the kinetics of...what, gang? Right, a second–order reaction in a well–mixed batch reactor. Now, after this run, just for fun we're going to say that Pete over there is a catalyst and unknown to him there's a trace amount of sulfur in the reactor, which he's deathly allergic to. Pete, as the reaction proceeds you'll start gasping and clutching your throat, and the rest of you...."

Interesting fellow, Furze—students like him but for some reason I've never understood, Frobish doesn't...ah, we've got a treat coming up now. There's Professor Snavely—he's teaching the sophomores this semester and always keeps them laughing.

Snavely: "...and that's the flow chart. You people understand?...wonderful! Now, what do we do next...let's see what our old friend Miss Albright has to say. Miss Albright—give us the benefit of your wisdom."

Student: "Um...I'm not sure what you're asking, Dr. Snavely."

Snavely: "Oh, really? Well, I'll try again, more slowly. Miss Albright. What...do... we...do...next? Got it that time? "

Student: "Uh...I guess we need to find the amount of CO_2 in the product."

Snavely: "The *amount* of CO_2 in the product. Miss Albright, have you ever had a chemistry course? Yes? Were you awake during the part of it when they talked about such esoteric concepts as mole fractions? You were. Amazing...hey, you there, the girl with the glasses. If you think you can teach this stuff better than I can why don't you come up and do that talking from up here. No? All right, then...suppose you tell Miss Albright here how she could determine the mole fraction of CO_2 once she learns what it's called."

Student: "Uh...I don't know."

Snavely: "You don't know? *You don't know?* Oh, I'm terribly sorry—this is CHE 247...you must have been looking for the medieval history class down the hall and wandered in here by mistake. Why don't you just..."

Lot of fun, isn't he? He's on a fast track here—brought in two million dollars in grants last year and is a shoo–in for tenure. He has terrible luck, though—three or four times a year his car turns

up with flat tires in the parking lot...you'd almost think someone was...say, there's lovable old Professor Wombat, teaching his course in process design. Believe it or not, he's taught that course since they started this department without missing a year.

Wombat: "...and that's the Chamber process, used to make most of the sulfuric acid we use today. Now I'm going to write a ten–year discounted cash flow rate of return on investment table for a typical plant...copy it carefully, since you will be responsible for it on the next test. After that I'll move on to the important reaction between steam and coke that gives us...watery coke...ha ha ha, a little humor there, class...actually it gives us *water gas* or *blue gas*, used as the fuel for many of the lights that illuminate our streets today. Now, the table...pay special attention to the interesting way they treat depreciation in Row 18...."

Look how the students are gently nodding their heads as they soak up the wealth of real–world information they're getting. Well, I think it's time to get back to...wait, there's Professor Buffo finishing up today's thermo lecture...looks like another 3–piece–of–chalk day from here.

Buffo: "...and the last problem is even more trivial. Look." (Writes on board)

$$dA = -PdV - SdT \rightarrow dA = \left(\frac{\partial A}{\partial V}\right)_T dV + \left(\frac{\partial A}{\partial T}\right)_V dT \;\&\; dG = VdP - SdT \rightarrow dG = \left(\frac{\partial G}{\partial P}\right)_T dP + \left(\frac{\partial G}{\partial T}\right)_P dT$$

$$\& \; dH = \left(\frac{\partial H}{\partial S}\right)_P dS + \left(\frac{\partial H}{\partial P}\right)_S dP \rightarrow V = \left(\frac{\partial H}{\partial P}\right)_S = \left(\frac{\partial G}{\partial P}\right)_T \text{ so } -S = \left(\frac{\partial A}{\partial T}\right)_V = \left(\frac{\partial G}{\partial T}\right)_P \;\&\; \left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$$

$$\rightarrow \left(\frac{\partial S}{\partial P}\right)_T = -\beta V = -R/P$$

Buffo: "...but only for an ideal gas, and the rest obviously follows. Is that clear? Good. Ok, next period we'll learn about some fascinating relationships between $\mu, \hat{f}, \phi,$ and if we have time for it, $\overline{G}$ and G_i^0. Class dismissed—don't forget the closed book exam on Friday."

Well, I'd better get back to the office. I'm just completing the report for our upcoming accreditation visit and I've got to establish that half of our curriculum is really engineering design—should be a piece of cake.