

on exams but can still display little understanding of the concepts underlying the problems' solutions."

Similarly, qualitative skills like estimations, approximations and proportionalities are seldom emphasized in conventional calculus-based introductory physics courses. But qualitative reasoning ability is a component of understanding: Michelene Chi, Robert Glaser and Marshall Farr<sup>5</sup> note that experts in various fields, including physics, spend considerable time in qualitative analysis and recognize large patterns: "Experts typically try to 'understand' a problem, whereas novices plunge immediately into attempting to apply equations and to solve for an unknown." Arons<sup>3</sup> says that students "exhibit very strong resistance to . . . thinking in terms of ratios and functional relationships. They want initial numerical values, and they want to substitute into the formulas without having to think." Although additional qualitative reasoning practice might be squeezed into the already crowded introductory semesters, it would more readily form part of a junior review class, in which physics majors might for the first time be in the majority.

From yet another viewpoint, the physics major's fifth semester is a point of convergence for several groups who especially need the junior review, including students who:

- ▷ are unmotivated in the introductory course and fall behind
- ▷ start the introductory course with deficient math skills
- ▷ are motivated but are undecided about being physics majors
- ▷ transfer from junior college
- ▷ change majors from another science
- ▷ begin preparing for the GRE
- ▷ want to teach in secondary school
- ▷ wish to minor in physics.

In the relatively large first two groups are students off to a slow start, who are usually given no reasonable second chance to catch up: On the one hand they face the awesome rigor of advanced courses, taught by professors who tend to assume that students *do* understand basic physics. On the other hand they can consider repeating the introductory course or, discouraged, may simply drop out. As Chiara Nappi (PHYSICS TODAY, May 1990, page 79) remarks, "the American educational system, which is generally perceived as . . . liberal . . . , is actually very selective. It selects the very talented and self-motivated students, those who would do well in any system. But it does not give a

fair chance to the others; it simply neglects them. Many students, if properly and systematically educated, can blossom."

As to the third group on the list, Sheila Tobias<sup>6</sup> debunks the popular mythology that "scientists are born, not made" by citing evidence that a majority of college freshmen who switch out of science do so not because of its difficulty but because other fields seem more desirable. Some students are still undecided about continuing as physics majors even after honorably completing introductory physics, which they found dominated by computational minutiae and lacking broad correlations. To maintain interest in practicing the necessary technical skills they also need exposure to long-range goals, the interrelation of concepts and "the big picture." Thus a message from Tobias's research is that student motivation is enhanced by overviews; an implication is that a junior review course could keep more of these people in the physics arena.

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## Surplused Research Professor's Shared Saga

I am both amused and irritated by Alex Lempicki's letter "Saga of the Surplused Research Professor" (March 1993, page 15). His anger is commendable, his self-pity misplaced. Let me start with the latter. We learn that after an apparently successful career in industry (where he certainly earned considerably more than his colleagues at universities), Lempicki was no longer considered essential and decided to move into academia. At a time when many

young physicists were having difficulty getting jobs, he succeeded (surely with rare good luck and the help of "connections") in becoming a research professor at a major university, at an age when it is most unusual to begin a new career. Now 70 years old, well beyond the average age of retirement, he complains that he no longer receives a salary and thus has become an SRP (Surplused Research Professor). True, he still writes grant proposals and even manages somehow to receive from agencies a "summer salary" as  $\frac{2}{9}$  of his (nonexistent) base salary. It is not clear if he uses the money solely to support research students and such (as he expects regular faculty to do).

The trouble with Lempicki is, he doesn't realize that SRPs are only a tiny subgroup of SOUP (Surplused Once Useful People). The SOUP family begins with old parents who are surplused by their children and put into old people's homes; it includes writers, musicians, politicians and artisans as well as scientists. Indeed, some SOUP are surplused several times in their careers. I know of an elderly colleague who, for ideological reasons, was surplused in his youth by both the Nazis and the Communists. He then moved to the West and had a successful career as a professor at a major private university, only to be surplused ("given the mashroom treatment," as Lempicki puts it) when his research field could no longer attract further grant monies. Undaunted, he began a new career as an administrator at a state university. After several successful and pleasant years he was surplused when the state's disastrous finances required "reorganization" at the university. A new job in a research administration position ended abruptly when he was surplused at the whim of an alcoholic president. Then came a third career in a respected branch of the government, but surplusing occurred once again when, after a few years, his term contract expired and the promised new position did not materialize (obviously because he lacked old-boy connections). Although not yet of the usual age, he gave up and retired to the countryside. As far as I know, he now successfully tends his garden and cares for his dog, quietly waiting for the time when the Good Lord will SOUP him—for good this time.

The moral? Count your blessings.

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