

Faculty members' response to this program was quite interesting: Many strongly approved, but a few found it unsettling—they just didn't get the idea that it was all right for a student to be both studying for a PhD and making plans to enter the real world. I perceived a bit of a conflict of interest between those few professors and their graduate students.

How well did it work? As a completely voluntary seminar, it was the best attended in the department; I received nothing but positive comments from the students. Several other institutions heard about the program and told me they wanted to emulate it. The seminar was held again the next semester, but my schedule wouldn't permit its continuation beyond that.

In tapping the resource, therefore, let us not overlook the one that is closest to us: our students, who will be beneficiaries of such programs.

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Academic physicists would do well to heed the advice given by John Rigden and James Stith. Physics alumni in all walks of life can be helpful to their former departments and to physics graduates. As a physicist who is now a professor of petroleum engineering, I have seen the benefits of alumni networking. I made the transition from studying the fundamentals of quantum mechanics to the fossil energy field using my computer modeling background.

Today, people are beginning to recognize the need to educate energy professionals, namely, people who can apply scientific knowledge to improve the overall use of energy.¹ Energy professionals will need to understand fossil, nuclear, wind, and solar energy, hydropower, and biopower. A golden opportunity exists for educators with the vision to see and the courage to act. Physics departments could be among those at the forefront of the effort to place properly educated people in the energy industry, if academic physicists are willing to embrace a new goal: educating technical students to succeed as energy professionals in a multifaceted energy industry.

Reference

1. J. R. Fanchi, *Energy: Technology and Directions for the Future*, Academic Press, Boston (2004).

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John Rigden and James Stith discuss a marketing problem in the academic physics enterprise by stating, "Most academic physicists begin and end their careers in an academic setting. Thus, they have no direct knowledge about the careers that the great majority of new physicists pursue." True enough, perhaps. However, in the very same issue of *PHYSICS TODAY*, I counted 278 descriptions of open academic positions, spanning 38 pages of the "Information Exchange" (that is, about one-fourth of the entire magazine), but only one industrial position, whose plaintive cry for attention occupied approximately 0.07 page. Perhaps this asymmetry in the help-wanted ads of *PHYSICS TODAY* also contributes to a perception problem among physics students regarding the nature of the careers that are out there.

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I have some heartburn about the views expressed by John Rigden and James Stith. The situation they describe—too few students and apprentices for the existing supply of mentors and instructors—fits a correction of an oversupply of teachers as well as it fits an undersupply of students.

There is an underlying assumption that physicists are a superior divine caste whose population must be preserved or increased if for no other reason than preserving the caste or employing the teachers. Physicists, as well as practitioners of other disciplines, are needed to solve problems outside academia, not to fill classrooms. Research into new areas and production of new knowledge are not the exclusive capability or property of physicists. Witness the tremendous volume of engineering and chemical publications.

Physics students tend to be taught that they have some unique capability to do anything. Employers tend to want someone with demonstrated ability to solve this or that particular type of problem, in a particular field, by a particular deadline. Students who obtain advanced degrees in any number of other technical fields may be well trained in basic physical principles and scientific methods and be equally (or more) capable of solving problems in their chosen fields. As a retired physicist and manager, I know both physicists and nonphysicists can solve technical problems well and

poorly. Finding the right person to solve the problem at hand is still a challenge. Physicist applicants who assert that they can "do anything" while having little detailed relevant experience might justifiably evoke laughter.

The idea of counting as physicists all students who obtain any degree in physics is a bit of a stretch. Many students change fields. Why shouldn't a person who obtains a BS in physics and a PhD in, say, electrical engineering or biochemistry be known as an EE or biochemist? A person who gets a BS in physics might get a job as a technician and rightly be referred to as such. It is not, and should not be, particularly important to society as a whole how many "physicists" exist or what criterion one uses in counting them. After all, many subjects now in other academic departments were once considered studies in physics and are still fit subjects for original research. A more meaningful number might be the fraction of the population trained in several technical disciplines.

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Rigden and Stith reply: Nigel Goldenfeld has a good idea with student-led seminars. It appears that students at the University of Illinois responded positively, so we say do it. Still, we emphasize that bringing alumni and students together is a win-win-win situation. The first victory is that students meet people who once walked the path they are now walking. The second, which is very important, is that by inviting alumni, we are saying that we value them. The third win is that alumni enjoy the opportunity to talk with students.

The energy industry is home to many physicists, and those we have met find that their physics education was a good preparation for their work. They would agree with John Fanchi, and so do we.

David Kohler suggests that we have no motivation other than the self-serving one of filling our physics classrooms. That was not in the forefront of our thinking. We believe a major in physics provides a powerful base from which a baccalaureate student can pursue a number of interesting careers, and the evidence supports this. Furthermore, we believe that faculty members have an obligation to acquaint students to the broad range of opportunities and to give them the tools to make informed decisions