THE LONELY PHYSICS TEACHER

Peter Lindenfeld

At a recent summer institute at Rutgers University, one of the participants was a teacher in a high school two miles from a major state university. He teaches children of faculty members, but otherwise his contact with the university is close to zero. He is an outstanding teacher, active in national organizations, effective and experienced. He works, as do high school teachers everywhere, largely isolated from others in his subject.

When we use the term "physics community" we normally don't even think to include the teacher as part of it. At best we think of him or her as an "object," someone to be taught, lectured to or "updated." But it is in the elementary and secondary schools that our children are likely to have their first exposure to science and to physics. It is here that the process begins that can turn students on to science or turn them off. This process produces the students who continue in science, and it lays the groundwork for attitudes towards science among those who do not. Whatever happens in the high school eventually influences our professional environment profoundly. It is hardly necessary to document the great need for our involvement. We are already paying a heavy price for our neglect.

For most of us, the schedule of our work and our private lives seems full. Yet the use we make of our time depends on the priorities we set. To spend time with teachers and with schools is to have the opportunity to affect the intellectual growth of children as well as the regeneration of our profession.

Clifford Swartz, in his article in the September 1991 issue of PHYSICS TODAY (page 22), looks back with longing to the days of the development of the PSSC course and the courses that followed, not just because of their innovative content, but also because they brought the teacher into the larger physics community. Just think of it: Half the high school teachers in the country were involved, as learners and, more importantly, as participants and developers. Today they are again alone, isolated in their classrooms, having sporadic contact, at best, with those who call themselves physicists. It is time to consider the teacher again as a colleague in our joint venture, as a member of the community that includes college and university professors and research physicists in industry and national labs.

The typical research scientist is ready enough to criticize the schools and the education establishment and to advocate that teachers take more of the standard science courses that are usually ill-matched to their needs and interests. Not unexpectedly, the physics departments of the major research universities are particularly aloof. We should probably be surprised that there are nevertheless occasional individuals who do get involved with teachers and schools, in the absence of any expectation of rewards or recognition.

Part of the problem lies with our vision (or lack of it) of how physics is to be taught. We plod on, step by step, in a sequence that seems uniquely logical to us. When, if ever, we get to the good parts, we are surprised that there are so few students left. That's a subject for another day, but surely we must bring more of today's science into the classroom. We can do it if we counter the trend towards more and more abstract and mathematical development, and return to experiment and direct experience.

Here we are likely to find strong allies among high school teachers. In the process we can help to make the teacher again a member of the professional physics community. Those of us in the colleges and universities and in the government and industrial laboratories will need to get involved, and the teachers themselves can also play a greater role.

Just as a professor in a university teaches at a variety of levels, the high school teacher can become involved in the development of middle- and elementary-school instruction. In a program at Rutgers directed by George Pallrand, the teacher–participants give workshops and make presentations to their colleagues in their own school systems as well as at regional and national professional meetings. It is their program, and they become the experts.

Physicists from teaching and research institutions can do more than make one-shot guest appearances at local schools. They need to develop continuing relationships with the teachers. By exchanging visits, they will learn more about the environment in which teachers operate, and the teachers in turn will see physics as it is practiced. As the relationships become real and no longer contrived, both parties will become more sensitive to one another, and a spirit of true collegiality will develop.

Visits, meetings, newsletters and workshops all help. Computer links, such as the American Institute of Physics's PINET network, are turning out to be particularly helpful: The teachers can communicate rapidly with each other, either one on one or with a whole group. Through electronic links the industrial and university physicists also become accessible and can more easily remain involved.

Most of us have learned to be reasonably secure in spite of the realization that there are vast areas of knowledge that will remain foreign to us. The high school teacher often finds it more difficult to overcome his or her defensiveness and sense of inferiority with respect to the research physicist. The research physicist can help by not being remote, obscure or patronizing and by being aware and respectful of the position, knowledge, experience and contributions of the teacher.

In the teaching institutions, we must rethink our courses and curriculums so that at least a part is appropriate for teachers and prospective

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teachers. The standard courses designed to prepare for a research career are seldom appropriate. Not only is there a need for summer, evening and Saturday courses for working teachers, but the subject matter needs to be quite different from standard science courses, with less emphasis on mathematical development and more on fundamental principles, on experiments and demonstrations and on the interface to the students. In addition to their primary objectives, such courses can also lead to the establishment of ongoing relationships. These rarely develop by themselves but must be planned and nurtured.

Teachers will need to break out of old molds. School administrators can help by understanding and supporting new modes of instruction. Most of all, we in the established physics community have to become more open and flexible. We have to learn to speak a language that is more widely understood.

Here, then, is a five-part program:
▷ *Enlarge the range of professional activities of the teacher.* New curricular materials should be developed in close cooperation with teachers. In the Rutgers program, the teachers write, criticize and improve their own material. They use the new units in their classrooms and come back to discuss what works and what does not. We try to ensure that their supervisors and principals give them the necessary freedom. The teachers become propagators and advocates as they work with other teachers and make presentations in their communities and to professional groups.

Sometimes there are part-time teaching positions available at community colleges, four-year colleges or universities, and well-trained, experienced high school teachers can often fill them successfully.
▷ *Make the teacher a true member of the physics community.* The Local Physics Alliance project run by The American Physical Society and the American Association of Physics Teachers continues to do a great deal to bring teachers together with other members of the physics community. (See PHYSICS TODAY, September 1991, page 48.) The excellent and effective Physics Teaching Resource Agents program of AAPT also continues. Many more personal relationships need to be built.
▷ *Revitalize the content of the physics courses in the schools.* There is no need to make the high school course a mini-college course. Let the schools be schools, and the colleges will take care of themselves. Students encounter exciting applications of modern physics every day—whether they know it or not—and the high school course should help them to recognize and understand the underlying scientific principles, as well as how these principles lead to the technology that has transformed our world. Let's not get trapped into teaching only prerequisites and no outcome, grammar without literature, technique and no ideas.
▷ *Develop teacher education programs that meet the needs of today's teachers.* Introduce hands-on experimental courses in which the teachers themselves develop ways to transmit science to their students. Courses such as "Elementary Physics from an Advanced Point of View" enable us to examine fundamental questions that are seldom emphasized: Just what is the content of Newton's laws and what are the various points of view that are possible about them? What are potential energy, voltage and temperature? What is an electric current? What is a beam of light?
▷ *Reward and encourage faculty members who work with teachers and schools.* Department chairs and deans create atmospheres that allow some activities to flourish and others to decline. They can foster work on courses and curriculums for teachers, promote alliances with schools and encourage faculty members to participate in teachers groups.

Just as was true in the PSSC days, it must again become respectable, and perhaps even rewarding, for faculty members and industrial scientists to contribute their time, thought and energy to working with teachers. Spare-time volunteer efforts are helpful but are not enough. Government funding agencies and private foundations have to support local, regional and national efforts.

The research community can do more than criticize and must move beyond lip service. If individuals and groups play their parts, we will be able to make the changes that can make the teacher a true member of the scientific community, contributing in new and more effective ways toward the dissemination of knowledge and the regeneration of the family of which we are all members.

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