Visiting Physicists Program

Graduate students are improving their knowledge of nonacademic physics careers through a program of visits to campuses by industrial physicists and trips by the students to see R&D laboratories for themselves.

Sidney Millman

I have a letter from a graduate student who writes "Many of us [students] are very ignorant as to the structure of research in industry." Another graduate student writes, about industrial research in physics, "I [had] suspected that there is greater pressure to produce and a generally less interesting environment than in an academic setting." It was to help counter these very prevalent attitudes that The American Physical Society set up its Visiting Physicists Program in 1973. In its current form the program arranges visits by physicists from industrial and national laboratories to university physics departments and visits by professors and their students to R&D laboratories, to improve the interaction between these two worlds. The success of this four-year-old program can be judged by its steady growth and by comments from those who have participated in visits, such as the two students quoted above. The first student's letter continues by praising the program for being both informative and interesting, and the second student, who had been suspicious of the R&D laboratories before his visit to one, writes "These feelings have been allayed by my visit . . . I am now much more favorably disposed toward the research environment at such institutions."

Origins and objectives

The Visiting Physicists Program was started by a Committee on Education set up by APS in January 1973. Among the stated aims of this new committee were the hope that it could influence the style and extent of graduate education in physics and the need to make faculty and students aware of the challenging technological problems in industry.

Following discussions with Conyers Herring at Bell Labs, I had already proposed a program of visits, by industrial physicists to graduate research departments, and by professors to R&D institutions, to the subcommittee that preceded the Committee on Education. (The Committee on the Future of The American Physical Society, also known as the Krumhansl Committee, had four subcommittees. The Subcommittee on Education was one of these; APS Council established the Committee on Education, mentioned above, upon the recommendation of the Krumhansl Committee.) The result of my proposal was that the Visiting Physicists Program became the first major activity of the new committee, in April 1973.

In initiating the program the Committee on Education noted that "at the present time there is good reason for the physics community to emphasize the importance of physics in industrial affairs. As a source of new understanding, ideas and techniques, physics has much to offer an industrial enterprise seeking an improved position, whether it be an improvement in its utilization of natural resources or its ability to compete successfully for markets. As a source of well-grounded, versatile and imaginative scientists, physics offers human resources of inestimable value when industry, faced with new problems, wishes to take new directions and needs to keep up with advancing knowledge.

"There is evidence of a mismatch between the career aspirations of able young physicists and the nature of the actual careers offered by industry." The committee stated the objectives of the new

An industrial scientist on campus. Richard L. Cohen of Bell Labs (left photograph) talks to students during his Phase-I visit to the department of physics and astronomy, University of North Carolina at Chapel Hill.

program in these two paragraphs:

▸ The purpose of this program is to increase the interaction between industry and PhD-granting physics departments.

▸ The program is predicated on the belief that visits to PhD-granting departments by highly-qualified industrial physicists who are currently engaged in applied research or development will broaden the education of PhD candidates and awaken them to the opportunities for creative work in industry. At the same time, the industrial physicists and the faculty of the departments participating in such exchanges will have the opportunity to gain mutual understanding of each others' problems and methods.

Note that the program in this initial form restricted itself to visits *to* PhD-granting departments *by* industrial physicists, which are somewhat easier to arrange. We now refer to these as "Phase I" visits. By the 1974–75 academic year the program was broadened to include visits by a professor and a few students to an R&D laboratory, and we call these "Phase II" visits. Both types of visits make up the program as it has operated since then.

This activity should not be confused with a now-defunct program with a similar name, the Visiting Scientists Program in Physics. This older program, administered jointly by the American Association of Physics Teachers and the American Institute of Physics under a National Science Foundation grant, ran for about 15 years, from 1957 to 1972. It aimed to stimulate interest in physics among undergraduate students through visits by leaders in the world of physics, mostly from the big universities, in order to acquaint them with recent developments in physics. Most of these visits were to the smaller colleges and to two-year institutions. By contrast, the emphasis in our present program is on the graduate departments of the big universities, with university–industry interaction the major goal. The earlier NSF-supported program provided honoraria for its visitors; the present program is not funded by outside agencies and does not provide honoraria.

Growth and scope

In October 1973 the first invitations to participate in the program went out to the 27 top PhD-producing physics departments (as listed in the *Physics Manpower 1973 AIP Register*) and to about 25 industrial R&D laboratories (chosen from among the bigger physics employers on the AIP Corporate Associates membership list). The industrial institutions were asked to designate two or three physicists on their staffs who would be particularly qualified to make the visits—Phase I only at this stage. Within a

Students visit Bell Labs. Robert M. Cotts, professor of physics at Cornell University, and seven graduate students from his department made this Phase-II visit to Bell Labs last October. Walter L. Brown explains the research activities of the ion-beam accelerator laboratory. Second from right is Venki Narayanamurti of Bell Labs, who arranged this visit; the author of this article stands at the extreme left.

few weeks about 90% of both the academic and industrial institutions responded favorably; arrangements for the first visits started soon after. By the second year, 1974–75, not only were the Phase-II visits added but also the invitation list was broadened to include several government laboratories and federally funded institutions.

Now after four years the number of university physics departments in the program has increased from about 25 to more than 60, and the participating R&D laboratories have increased in number from the original 23 to 40.

Table 1 lists the participating university departments, including the few who have asked to be included in the program but have not yet been involved in a specific visit of either type. The list does not include three departments from the original 25 that either never went through with the arrangements for their first visit or tried one visit and then dropped out. On the other hand the table does identify the 16 departments that have already been involved in four or more visits.

Although, as I mentioned above, this program was designed with the larger PhD-producing departments in mind, you will notice that smaller departments are not excluded. Their participation is the result of initiatives by the department chairmen or Employment Information Officers, who have in these cases specifically asked that their departments be included in the planning for these visits.

Participating R&D laboratories, both the industrial and the government and federally funded institutions, are listed in table 2. None of the industrial laboratories that responded favorably to the original 1973 invitations has dropped out, although six of the current list of 40 have not yet accomplished their first visit. The table identifies 15 that have taken part in four or more visits.

The number of visits that have been made in the last four years has also been increasing from year to year. The number of Phase-I visits for the four successive years starting with 1973–74 were 20, 24, 27 and 24, respectively, while the Phase-II visits, which started a year later, amounted to 5, 6 and 9, respectively. The apparent drop in Phase-I visits for the 1976–77 academic year is not significant, because an unusually large number of visits—ten—originally scheduled to take place in that year were deferred until 1977–78.

The way it works

The first steps in arranging a given visit consist of some "matchmaking" telephone calls through which I try to match the expressed preference of the visitor to the wishes of the host. Although the confirming letters that follow mention an approximate date for the proposed visit, the host and visitor themselves set the actual date and make the detailed arrangements.

Then, in a Phase-I visit, the physicist from an R&D laboratory typically spends about two days in a university physics department. During this time the visitor is given opportunities to speak formally to the faculty and students, and to meet with students informally and individually, to give them a realistic picture of a physicist's role in applied research or development. The visitor's own line of research together with that of his or her colleagues will normally cover a wide range, probably including areas of physics far removed from the graduate students' thesis research.

Phase-II visits have the same goals, but here a professor and a few graduate students spend a full day at an R&D laboratory visiting several experimental set-ups, chosen to show how physicists play a leading role in the solution of technological problems.

For Phase-I visits there is essentially no expense involved for the physics department, since in every case so far the sponsoring R&D institution has taken care of travel expenses of the visitor. For a Phase-II visit, the host is not asked to provide the travel and hotel expenses of the professor and students, although some hosts have paid the hotel expense. The expense is generally borne either by the physics department or by the Committee on Education, or shared.

How successful has it been?

I have already pointed to the growth in the number of participating institutions as one measure of the popularity of the program. Another guide, at a more individual level, is the enthusiasm shown by

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the physicists who are making the visits. They generally find the experience sufficiently rewarding that they are willing to take time off from their busy schedules to make another visit a year later. About 15 physicists have been involved in three or more visits and, of these, five are on their fourth visit.

Feedback letters from visitor and host, solicited after each visit has taken place, are especially valuable in gauging its success. Members of the Committee on Education are particularly interested in students' comments, expressed in letters such as the two quoted in part in the opening of this article. These and other letters from students have expressed their approval of the visits in terms beyond what might be expected from normal politeness. A recurring theme of the letters is the desire that the program be continued at the writer's institution in the following years. Many students have specifically mentioned their awakened interest in job opportunities in the non-academic sector following one of these visits.

One Phase-I physicist visitor wrote us: "Discussion ensued for at least two hours following the presentation of my introductory VuGraphs. The discussions were characterized by intense interest on the part of faculty and students alike. In my opinion, [the writer's company], the academic community and the APS all benefitted substantially from the dialogue represented by the discussions."

A student questioned the emphasis of the program on the *physics* being done in the industrial laboratory he visited. He wrote "I believe that there is a rather high transfer rate of physicists to data processing, and it is regrettable if a major portion of a lab's work is in this area without our getting some exposure to it. More generally, the trips seem to be oriented toward only looking at the physics done in the labs. A somewhat broader viewpoint might be desirable."

Some of the professors who have accompanied students on Phase-II visits notice particularly how the training they give their graduate students is put to use in an industrial setting. For example, one wrote ". . .I recall a group using digital computing techniques to work on medical instrumentation. It is easy to see how the training a graduate student receives in physics would be useful in such a pursuit." After a second Phase-II visit the same professor wrote "The fact that we saw a group of people trained in nuclear physics using particle-channeling techniques to study surface impurities was a graphic demonstration of the broad nature of the experimental physicist's training."

The Committee on Education is particularly gratified by a letter from a former graduate student who had earlier made some critical comments about one of the visitors, supplementing his remarks by making very helpful suggestions. He

Table 1. Participating university physics departments

* Arizona State University
Brown University
CalTech—Applied Physics
• U.C. Berkeley
U.C. Davis
U.C. Riverside
U.C. San Diego
Case Western Reserve
• University of Chicago
University of Cincinnati
Clark University
Cleveland State
* Colorado School of Mines
University of Colorado
Columbia University
• Cornell University
Georgia Tech
• Harvard University
• University of Illinois
Johns Hopkins
University of Louisville
* Madison College
* Marquette University
University of Maryland
• MIT
Michigan State
University of Minnesota
University of Missouri, Columbia
University of Missouri, Rolla
CUNY City College
CUNY Queens College
SUNY, Albany
• SUNY, Binghamton
• SUNY, Stony Brook
• New York University
North Carolina State
• University of North Carolina
North Dakota State
Northwestern University
University of Notre Dame
• Ohio State
Ohio University
• Penn State
• University of Pennsylvania
University of Pittsburgh
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rice University
University of Rochester
San Diego State University
University of Southern California
University of South Carolina
• Stanford University-Applied Physics
Stevens Tech
University of Tennessee
University of Texas, Austin
• Virginia Polytechnic Institute
University of Washington
Wayne State University
Western Michigan University
* College of William & Mary
University of Wisconsin, Madison
University of Wisconsin, Milwaukee
• Yale—Applied Science & Engineering

* Universities that have not yet been involved in an actual visit
• Universities that have been involved in four or more visits

Table 2. Participating R&D laboratories

• Aerospace Corporation, Los Angeles
Avco Everett
• Bell Laboratories
Boeing Aerospace
Computer Sciences Corporation
• DuPont
• Eastman Kodak
• Exxon
• Ford
• General Electric
General Motors
* General Telephone
B.F. Goodrich
Grumman
Hewlett-Packard
• Hughes
• IBM
* McDonnell-Douglas
3M
Perkin-Elmer
• Philips Laboratories
RCA
Rockwell International
Schlumberger-Doll
Shell Development
• Texas Instruments
• Union Carbide
US Steel
Uniroyal Tire
United Technologies
• Westinghouse
• Xerox

GOVERNMENT LABORATORIES AND FEDERALLY-FUNDED INSTITUTIONS

Air Force Geophysics Laboratory
A.F. Rome Air Development Center
Argonne National Laboratory
* Lawrence Livermore Laboratory
* Los Alamos
• National Bureau of Standards
Naval Research Laboratory
Oak Ridge National Laboratory
Sandia Laboratory

* Institutions not yet involved in a specific visit arrangement
• Institutions that have already been involved in four or more visits

A one-day Phase-II visit

On 20 February 1976, Professor Henry Stroke and ten graduate students from the physics department of New York University visited Philips Laboratories in Briarcliff Manor, New York. Here is their schedule:

9:30–10:30	**Introductory Session**	
	Welcome by Dr. D. D. King, president of Philips Laboratories	
	Brief description of the NYU research program by Professor Stroke and students	
	Brief description of Philips' research program by Dr Stewart Kurtz and Dr Ramesh Bhargava	
10:30–12:00	**Tour A** (half the visitors)	
	Electrophoretic displays	Dr Dalisa
	Crystal growth	Dr Zwicker
	Luminescence	Dr Bhargava
	Electron microscopy	Mr Sicignana
	Tour B (half the visitors)	
	Pyroelectric Vidicon	Dr Stutt
	Nonlinear optics	Dr Choy
	Tunable lasers	Mr Zernicke
	Peltier epitaxy	Dr Blom
	Theoretical physics	Dr Smith
12:15–1:15	**Lunch**	
	Reserved table in company cafeteria	
1:15–2:45	**Tours A and B**	
	Groups reversed	
2:45–3:15	**Demonstration**	
	The Video long-playing disc	Mr Kohler
3:30–4:30	**Discussion**	
	Lobby Lecture Room. Discussion on the role of the scientist in industrial research and the effectiveness of graduate training programs in preparing students for careers in industrial research. Question and answer period.	
4:30–5:30	**Social hour**	

has recently become an assistant professor in a physics department that had not previously participated in the program. He now writes (in part), "As a graduate student of the University of ____ I enjoyed the visits of industrial physicists arranged through your office . . . Now at the University of ____ I would like to arrange a similar visit here."

I should add that I now have two Phase-I visits arranged for his department, to take place during the 1977–78 academic year.

In view of the very favorable reception of the Visiting Physicists Program by the physics community, we plan to continue the program for the foreseeable future. We expect approximately the same number of visits to be scheduled for 1977–78 as in the previous year, with perhaps some increase in Phase-II visits. I would urge those chairmen of physics departments who feel that not enough visits have been scheduled for their campuses to communicate their interest to me.

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I would like to express my appreciation for the encouragement I have received from the three successive chairmen of the APS Committee on Education: Ronald Geballe, Eugen Merzbacher and Roger M. Herman, and from Bell Laboratories. I would also like to acknowledge helpful discussions about the progress of the program with my American Physical Society office colleagues: Mary L. Shoaf, Joseph A. Burton and W. W. Havens, Jr. □