# NEWSLETTER

## of the FORUM on PHYSICS and SOCIETY

Volume 3 Number 1 April 1974

# SPECIAL ISSUE ON GRADUATE EDUCATION

Papers From Mini-Conference On Physics Graduate Education

Short papers and notes from the Forum sponsored Mini-Conference on Physics Graduate Education are reproduced on pages 6 through 14 of this Newsletter. The conference was held on December 27, 1973 at the Berkeley meeting of the American Physical Society. Its purpose was to collect ideas for the upcoming Conference on Tradition and Change in Physics Graduate Education. There were about 100 participants in the Mini-Conference, and all submitted papers have been printed here. (The Forum hopes to have other Mini-Conferences. Suggestions for topics?)

Graduate Students-Graduate Education

The Conference on Tradition and Change in Physics Graduate Education is now being organized. The purpose and program of the conference are described on the back page of this Newsletter.

The conference committee is eager to have full participation by graduate students in the talks, the panels and the sessions of the conference. The conference is open to all physicists, students and non-students; the site has been chosen to minimize travel expenses and living costs; and the committee is trying to arrange for funds to help students with travel costs. Please write to the address given on the back page for more information.

# FIRST FORUM AWARDS

The first awards of the Forum on Physics and Society will be presented at the Washington Meeting of the American Physical Society

THE LEO SZILARD AWARD FOR PHYSICS IN THE PUBLIC INTEREST

To DAVID R. INGLIS for his deep commitment over three decades to international control of nuclear weapons and to stopping of the strategic arms race. He has been an effective organizer and an intellectual leader in these areas. And above all, he has always spoken out plainly and fearlessly in order that the public could understand and judge these issues.

THE FORUM AWARD FOR PROMOTING PUBLIC UNDERSTANDING OF THE RELATION OF PHYSICS TO SOCIETY

To RALPH E. LAPP for his extensive writings and many books educating the public, the government and the scientific communities on the nature and hazards of nuclear radiation, the properties and dangers of nuclear weaponry and the complex problems associated with nuclear power. His books, such as the pioneering Voyage of the Lucky Dragon, The Weapons Culture, and more recently The Logarithmic Century have simply but accurately provided information on these issues to citizen as well as scientists.

## FORUM OFFICERS FOR 1974

Barry M. Casper, Carleton College, is the Chairman.

The newly elected Vice-Chairman is I. Richard Lapidus, Stevens Inst. of Technology. He will be Chairman next year.

The new Secretary-Treasurer, elected to a two year term, is E. Kevin Cornell, American University.

The two newly elected members of the Executive Committee are Joel Primack, Univ. of California at Santa Cruz, and James Sullivan, Center for Science in the Public Interst.

Anne H. Cahn, Harvard Univ., was appointed to the Executive Committee to replace Earl Callen, who resigned.

The Council of the American Physical Society has re-appointed Eugen Merzbacher, Univ. of North Carolina, and has appointed Marvin Goldberger, Princeton Univ., to the Executive Committee.

Other members of the Executive Committee are Elizabeth Baranger, Univ. of Pittsburgh; Paul Craig, National Science Foundation; Seymour Koenig, International Business Machines, who is also Forum Councilor; and Martin Perl, Stanford Univ.

## APS ENERGY CONSERVATION SUMMER STUDY

Although funding has not yet been obtained, it seems likely that there will be an APS-sponsored summer study of Technical Aspects of Efficient Energy Utilization. To be held at Princeton University during a five-week period in July or August, the study will be divided among four topics, each involving approximately five participants: 1) Examination of the Potential Contribution of Basic Physics Research to the National Goal of Energy Conservation, 2) Systems Analysis of Interconnected Small Electricity Generating Facilities, 3) Energy Conservation Through the Use of Selective Coatings, and 4) Use of Petroleum-Water Emulsions as Fuel. Individuals interested in participating in this study, if it takes place, should submit vita to Mike Casper, SLAC, Stanford, Calif., 94305. Please indicate which topic you would like to work on and any special qualifications you have in that area.

## APS AND PUBLIC POLICY ACTIVITIES

In recent months, the APS Council has become increasingly concerned with defining an appropriate role for the Society in dealing with public policy matters. In addition to the Congressional Fellowship Program, the APS will sponsor studies this summer of nuclear reactor safety, technical aspects of efficient energy utilization, and radiation effects on materials. At its February meeting, the Council delegated to the APS President authority to respond to requests for advice from Congress with comments or testimony; the response will be in the name of the APS President, possibly with the additional endorsement of the Council Executive Committee, or the full Council. In consultation with the Executive Committee, President Panofsky has already submitted on request two letters to Senators concerning proposals to reorganize federal agencies to deal with energy policy.

The Council has also established an ad hoc committee to consider the possibility of hiring a full-time APS Washington representative. This individual would not function as a lobbyist for physics interests; rather he or she would provide the Congress with access, in a useful form, to the technical advice and expertise that APS members can contribute. Such a representative would also provide information on social and professional issues to the membership.

The Council needs feedback from APS members on a number of questions related to these activities. Should the Society become involved in the public policy process? If so, how should the Society organize itself to do so? What should be the role of the Forum on Physics and Society? Is it appropriate for the APS President or the APS Council or the APS as a whole to take a public position on public policy issues? Is it possible to organize APS public policy activities in such a way that "APS positions" are avoided ?

The response of APS members to these questions is vital in determining how the Society is to proceed. Suggestions and proposals in a form suitable for circulation, should be forwarded before the end of May to Forum Chairman, Mike Casper, SLAC, Stanford, Calif. 94305.

## NEWSLETTER OF THE PROGRAM ON PUBLIC CONCEPTION OF SCIENCE

William A. Blanpied

Since October 1972 I have been editing an informal, quarterly Newsletter which is designed to serve as a medium of communication between individuals and groups that are involved in some aspect of the public understanding of science area — or that have ideas on the subject. Communications from Forum members would be welcomed. Anyone who would like to see a back copy and be placed on the mailing list can write me:

William A. Blanpied
Jefferson Physical Laboratory
Harvard University
Cambridge, Massachusetts 02138

Please mention the Forum when you write. The Newsletter is distributed gratis, thanks to the NSF.

## A New Newsletter — The PUBLIC INTEREST LETTER

James Sullivan

The Center for Science in the Public Interest (CSPI), a Washington-based group of scientists, engineers, and community organizers has initiated two projects aimed at involving more scientists in "social action" activity. The first project--a technical matching service--feeds requests for technical help from community groups to scientists who might want to volunteer spare talent to the cause. The second is a new publication called Public Interest Letter.

The Letter provides news of what is going on in the public interest arena, some analysis of where that action is headed, how an individual can make his or her contribution, and whom to contact to get involved. The Letter's goals are to draw more scientists and other professionals into government decision-making as well as to match professionals with environmental, consumer, and poverty groups that need their help.

CSPI hopes to swell the ranks of scientists who are already getting involved in public interest work. Professional societies are offering technical expertise to community groups; other societies are now polling their members to find potential volunteers. Scientists and engineers have also signed on as permanent staff members to public interest law and research groups. (There is even a shortage here. The groups complain of difficulties in finding technically trained individuals who have broad enough background and interests for the work involved; a typical "public interest" physicist's job might consist of research, testifying, writing, speaking--maybe even some radio and TV work.)

To find out more about public interest opportunities or to receive Public Interest Letter contact Dr. James Sullivan at:

Center for Science in the Public Interest
1779 Church Street, N.W.
Washington, D. C. 20036
(202) 332-6000

## Letter — Physicist Identity

To the Editor:

I was pleased with the selection of topics covered in the July 73 Newsletter of the Forum on Physics and Society.

On the other hand the manner of coverage misses a role which the Newsletter should strive for — namely the building of a physicist identity. For example we would all agree that women physicists should receive fair treatment; however I was not involved by the article as I would have been had there been a reportage of an example of discrimination and how it was accomplished. I then would review my own attitude toward the example against an editorial implication of what the proper attitude for a physicist should be.

It seems that lack of consensus on a physicist identity causes us much trouble. I would say from my experience with the AIP placement service that the format did not seem to represent me or the prospective employer and some of the statistics that might be derived from counting people and jobs were surely misleading. I would hope that improvements have been made since I used the service. I know many employers who were very very disappointed with the man they hired when they requested a physicist; and spoke against physicists in general as a result. In some instances I thought the employer, in fact, had not wanted what he asked for because he didn't understand the term, physicist, and there was no way for him to learn except by tragic error.

Some of our problems with government have their source in our requests for freedoms and security for which we pledge a certain discipline of our actions. The requests, separated from the pledge, sound like petulant demands and are treated as such. At other times the facts of life about the cooperative structure of research are not stressed and are violated by some of our own spokesmen for their own advantage. A stronger consensus on a research reward system, the need to publicize scientific discoveries, and the worth of the individual would earn us greater respect.

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## Letter — Chairpersons and Chairmen

To the Editor:

With reference to the December 19,3 issue of the Forum Newsletter, although I have a personal abhorrence of the term "chairperson" and other such illegitimate offspring resulting from the ravishing of our fair language by the brutal exigencies of politics, I am perhaps willing to admit the possibility that such abhorrence results as much from a lack of familiarity as from a general objection to recent socio-political cant. Therefore, if one is to make serious use of the term, and by implication to delete patently sexist references, it seems to me that referring to the only two women mentioned in the Newsletter (Cahn, p. 1; Ray, p. 5) as "chairpersons", while the remaining men (Perl, Gibbs, p. 2; Casper, p. 4; Perl, p. 6) all are "chairmen", completely misses the point. In that same vein it should be noted that repeated references to "Congressmen" and to the APS Congressional "Fellows" program all are in need of modification, although resistance to altering the latter is sure to arise from the program director, whose name is Millman.

On the other hand, one would hope that as physicists we could keep above this sort of nonsense and allow ourselves to acknowledge and be acknowledged both as individuals and as professionals. Discrimination against Blacks, Indians (sorry, Native-Americans), or Orientals will not diminish when our language is excised of idiom ("black-hearted", "red-handed", "yellow streak"), nor am I better able to relate to Ms. Cahn knowing she is a "chairperson" rather than "chairwoman" (or even "chairman", for that matter). Instead let us, as allegedly among the most learned of our society, take the lead in resisting the intrusion of politics into our most mundane affairs and bravely protect this assault upon our literary sensibilities. It is, after all, the manly thing to do.

Kenneth S. Krane
Univ. of California
Berkeley, California

## Courses In Physics and Society
## Letter from Dietrich Schroeer

The Forum has appointed me chairman of the "Subcommittee on Courses in Physics and Society". The purpose of this committee is not established in detail. As I would like to incorporate the broader Forum membership into its activities, I am writing this open letter to invite your comments on its possible organization and functions, and to ask you to indicate any interest you might have in participating in any of its activities.

Let me outline my thoughts on possible purposes of the committee to give you specifics to which you might respond:

It seems to me that for the Forum the word "course" really implies "understanding and education" in a more general way. I.e., I see this committee as being concerned with helping with the general understanding of the relationship between physics and society, and with thenspreading this understanding through education, including courses. My view enlarges the concept of the committee somewhat beyond what one might expect from the word "course", since that word implies limiting the concern to schools, colleges and universities. But that expansion is appropriate since the APS is a society for all physicists, not only for teachers and students.

This education should then go in three directions. Certainly there should be thought on how to get "physics and society" into curricula, and how to help teachers to understand this issue. This ought clearly be a joint activity with the American Association of Physics Teachers. I hope for example that this committee in cooperation with the AAPT might act as a clearinghouse for courses on "physics and society"; finding out who is teaching such courses, correlating their diverse approaches, and establishing critical reading lists and collections of teaching aids.

But there are two other groups who could "use" education to increase their understanding in this area; namely the general public and the professional physicists. The education of the general public to the problems and possibilities offered by science overlaps ones of the functions of the AAAS. Some effort should be made to cooperate with them, contributing the unique viewpoint of the active physicists — as well as investing some direct efforts of this committee.

It is however particularly in the area of self-education that I see the unique possibilities and responsibilities of this APS Forum subcommittee. Should this committee not help direct a self-evaluation and self-education of the APS. There could be a series of talks at APS meetings given by people, outside or on the edge of physics on how they view physics — e.g. social historians of science, sociologists of science, political scientists — all to give an outside perspective. One might prepare a small critical list of interesting and relevant reading to allow a physicist to acquire such an outside viewpoint through selfeducation. A conference on "social responsibility and education in physics" might be called to bring together teachers, researchers, industrialists and government officials. All these suggestions are motivated by my belief that dramatic changes in the physics community are taking place, and that some anticipatory response based on understanding is called for.

I am looking forward to your comments and will welcome any expressions of interest in working in this area.

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Chapel Hill, N.C. 27514

## Responses by Graduate Schools to the Ph.D. Market of the Future: The Case Against Elitism *

Bruce Rosenblum, University of California at Santa Cruz

A frequently proposed response to the "Ph.D. Surplus" is the suggestion that only the best, the most brilliant and highly motivated students should be encouraged to do research and be awarded the Ph.D. This is what I call "elitism". It appears to be our "conventional wisdom".

There are some obvious questions that this approach raises: (1) Can we judge our students well enough and early enough? (2) Is the narrow academic excellence we can easily judge the thing we should increasingly emphasize today? (3) How large need our graduate education establishment be to produce only the physicists required in elitist jobs? (4) Does the elitist response take a very narrow view of the value of graduate education in physics? The "obvious" answers to these questions form the argument against the elitist response.

But what should be the response? What changes are appropriate, if any? Let us examine the environment of the 50's and 60's in which our physics departments grew very large and developed their present character, and then look at today's environment and see if this character is still appropriate.

In those boom years for physics: (1) Colleges and universities expanded without precedent; (2) Physicists, by doing pure research, had recently discovered things that led to atom bombs, radar, transistors and lasers; and (3) Three immature technologies, modern electronics, aerospace and the nuclear technology had appeared, each of which felt the need for fundamental physics research and for physicists (even physicists for "engineering" jobs for which no one else was quite qualified).

Physics departments expanded to produce the needed physics faculty, the physics researchers for industry and government (and the physicists to fill those "engineering" jobs). The dollars were plentifully supplied for physics research by people who, in the back of their minds, expected new "breakthroughs". Not only were there lots of jobs for Ph.D.'s, but for all the "better" students there were jobs in which they could continue to do "thesis-like" research in or out of academia and, to a large extent, follow in the footsteps of their faculty advisers.

In this heady atmosphere the faculty could strongly emphasize in the training of Ph.D.'s that which was of most interest to the faculty, i.e., the frontiers of the discipline. What was of most interest and best for faculty prestige was best for the students. In a sense the larger physics community controlled the hiring of the Ph.D.'s and could set the standards in keeping with its own taste. All this affected the courses taught, the research projects selected and the attitudes

instilled. Our departments today are the natural product of the environment of the 50's and the 60's.

But that environment did not last. Today: (1) The expansion of the colleges and universities is over and the faculties are still far from retirement. (2) It has been many years since the bomb and the transistor; physics has gone a long time without a "breakthrough"; it is not even anticipated any more. (3) The three immature technologies have matured and feel much less need for basic research (and engineering departments now produce people for their "engineering" jobs for which physicists were once the only ones qualified). There are no major immature technologies today with a clear need for much physics research. The fortuitous coming together of basic physics research and technology we saw in the 50's and 60's may well be a phenomenon that will not be repeated for a very long time.

In this changed environment it is appropriate to rethink the courses taught, the research projects selected and the attitudes instilled if our large physics graduate education establishment is to be worth maintaining. And it is. In our increasingly technological society problems involving varied physical phenomena will constantly be important. Physics is a collection of knowledge, techniques and approaches that can be widely useful. There are many roles for the physicist, and there should be plenty of jobs for people with appropriate physics training. Educators must determine that appropriate training if they expect continued support.

The changes needed will certainly include some increased emphasis on applications and a decreasing concentration on the frontier, but that cannot go very far. A greater breadth (albeit at the expense of depth) will probably benefit the student. There is, surely, no single best way to adjust. But we will have to pay attention to things outside our own discipline. To have to alter our faculty ways in response to external pressures is not pleasant and will be resisted. The acceptance of a somewhat lower status always is. Unfortunately, refusing to admit the truth will not make it go away.

One more point in this connection. The abilities of the faculties in physics are such that they can do less for today's graduate students than they could for those in the past, who would, to a greater extent, follow in faculty footsteps. An obvious conclusion from this is that the time a student spends with the faculty obtaining his Ph.D. should be reduced from the present five or six years.

We need many changes in our new environment, but they are <u>not</u> drastic ones. Our departments must always be skewed in favor of those few students who will always be able to follow research careers at the frontiers of our discipline. This will be easy to assure.

* This is not an abstract of the talk I gave at the December APS meeting but it treats many of the same points.

## NEW DIRECTIONS FOR GRADUATE EDUCATION IN PHYSICS?

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At the December APS meeting in Berkeley I attended the Forum on Physics and Society session on graduate education. It was an educational and a discouraging experience. Although many ideas were presented and discussed, the basic problem with physics as it is taught today was totally overlooked. In fact the existence of this problem was, at least by implication, denied--even as this implicit denial illustrated the problem more effectively then it could ever be stated.

Nasrudin once visited Mecca. After his return to his own village he created quite an impression by announcing that while there he had learned to speak arabic. His friends at the teahouse were enthusiastic in pressing him to speak just a little arabic for them.

"Just one word Nasrudin, please."

Finally Nasrudin agreed to speak a single word of arabic. One person suggested that he say the word for camel. "Oh no" Nasrudin replied, "a camel is much to large an animal." Another person then suggested the word ant. "No," said Nasrudin, "an ant is far too insignificant." At last a compromise was reached with the word for lamb. Nasrudin said, "Yes, lamb is quite acceptable but unfortunately there were no lambs born while I was there and so I did not learn that particular word."

There were two statements put forth at this APS forum which together tell the story. The first was made by an industrial physicist who stated that he was highly interested in finding good applied solid state physicists to hire, and that such people were extremely difficult to come by. The second was made in response to the question "What are the primary characteristics of a physicist?" The answer given and generally

accepted by the audience was that a physicist was a problem solver, a person who searched for basic last and then applied these to the solution of practical problems.

This is a comfortable fantasy but it is not true. If it were true new Ph.D.'s in solid state physics would have little difficulty in making the switch to applied industrial solid state physics. If it were true there would be no employment problems for physicists. Problem solvers have always been at a premium and if graduating physicists had any special problem solving ability which had been imparted to them by their education in physics then employers would be hanging around university physics departments like starving wolves.

The difficulty is that physicists are all too willing to believe that they are problem solvers when they are not, and having told this basic lie they soon find themselves in the position of Nasrudin. Employers on the other hand are, out of monetary necessity, far more clever then Nasrudin's teahouse companions and soon realize that in hiring a physicist they are getting not a generalist but a highly specialized machine, one which is usually not capable of performing any useful function.

Until this is recognized and corrected society will continue to place a low value on a Ph.D. in physics. Further, correction of this problem must begin at the earliest undergraduate levels. It is already too late when a student has received his B.A., his basic attitudes have already been conditioned. Physicists should be problem solvers and this is what an effective education in physics should produce. If not physics will continue to loose appeal, and more important, will no longer attract really good students. This last is a process already underway--the most imaginative and enthusiastic graduate students and young scientists whom I know are, with few exceptions, not physicists.

As a possible remedy to this situation I would suggest that both graduate and undergraduate education in physics be

drastically revised with less concentration on specialization and far more on teaching general techniques of problem solving using classical physics subject matter more as examples than ends. It might, for example, be of some benefit to study the teaching methods used by R.L. Moore at the University of Texas. Although designed for the teaching of pure mathematics there might be some possibility of adapting such methods to the teaching of physics. Other possible programs could involve the offering of interdisciplinary degrees which were truly interdisciplinary. The ultimate form of the solution is not clear at this point.

One thing, however, is certain. This solution cannot even be conceived until physicists are willing to admit the problem.

The Forum and Newsletter

The Forum on Physics and Society is an official organization within the American Physical Society. All members of the Forum are members of the American Physical Society.

This Newsletter is distributed, through the APS, to the Forum membership. Others who would like a copy should write M. Perl, SLAC, Stanford, California, 94305.

Letters, comments, editorials, and articles for this Newsletter should be sent to the Senior Editor, Jay Orear, Cornell Univ. The Newsletter is arranged by M. Perl; and Forum news items which do not require Newsletter Committee approval should be sent directly to him.

# Physics Graduate Education and Public Interest Science

Martin L. Perl
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## What Is Public Interest Science

The silver lining in the energy crisis cloud is that the nation is finally faced with the realization of the tremendously complex interlocking of technology, the economy, and the quality of life. Haphazard growth of technology, and unconscious but overwhelming dependence on specific technologies can be destructive of the economy and the quality of life. New technology should not be introduced and spread simply for the benefit of a particular segment of the nation, but always the interests of the public must be considered. How this is to be done is an enormous problem in democratic decision-making. But essential to that decision-making process is the presence of a large number of people doing public interest science. This public interest science is both basic and applied. It has two goals:

(1) the development of new knowledge and technologies which will improve the quality of life.

(2) the use of scientific knowledge and method to protect the public as a whole against the possible harms and dangers of existing and emerging technologies.

Unfortunately these goals are often contradictory.

Public interest science is a large and growing field. It has to do with environmental protection, with the reduction of pollution, with energy conservation, with the search for new sources of energy, with arms control and disarmament, with chemical and biological warfare. In short, it has to do with many of the uses and abuses of technology in modern life. And so the doing of public interest science imposes two special requirements.

First, and obviously, the public interest scientist must be prepared to work on problems involving two or three different sciences — that is, to work in mixed sciences. And he must be prepared to solve unconventional problems. I call this the mixed unconventionality requirement.

But in doing public interest science, one faces an additional requirement. It is not enough to recognize and warn about a present or future technological problem, it is not enough to find a new solution or invent a new device to solve that problem. It is not enough to do the basic science or lay out the prospects for a new and needed technology. The new device, the new solution, the new technology must be nurtured, protected and supported through a long and chaotic political approval process; a process which involves all sorts of economic and ideological considerations and pressures. The public interest scientists must lend a hand in this process if his work is to be ultimately useful. It is often relatively easy to give or to get sound technical and scientific advice, the problem is to implement that advice. This is the implementation effectiveness requirement.

## The Traditional Education

Traditional physics graduate education, as developed in the late nineteenth and early twentiety century has two parts : an almost fixed, but broad, set of physics courses; and a doctoral thesis. Both parts are necessary, but the thesis work is most important. When considering a recent Ph.D. for a position we always inquire

about his thesis research, we rarely ask about his course grades. The emphasis in the doctoral research is on making a contribution to basic knowledge in physics and this usually requires intensive work in a narrow area. The fundamental object of this research training is to teach the student how to do basic research in physics. One learns by doing, and it has clearly been a very successful teaching method.

But is it the best way to prepare physicists for public interest science? Does it train them in the requirements of mixed unconventionality or implementation effectiveness? The traditional answer is that the traditional physics training does teach mixed unconventionality. As for the implementation effectiveness requirement, the argument is usually that one picks that up afterwards.

Doctorates in Public Interest Physics?

Nevertheless we ought to question whether the traditional training is necessarily the best for physicists who will do public interest science. I have a proposal to make for an alternative method — a proposal for doctorates in public interest physics. I would reduce the physics course work a little and I would add the equivalent of a year's course work in biology, chemistry and perhaps some engineering. The student would select this year's work.

The heart of the alternative method would be a change in the nature of the doctoral thesis itself. The thesis work, two or three years long, would be in the application of physics to a public interest science problem. We would follow the principle of learn by doing. A requirement of the thesis subject would be that it must require some active interaction ouside the university laboratory. That interaction might be with industry, with an environmental group, with a municipality, with the federal government. Let me give an example of each:
With industry: development work on a commercially feasible, high-power, fuel cell. The thesis work might be mostly done in the industrial laboratory.
With an environmental group: laboratory tests and computer models of methods of long term containment of radioactive waste.
With a municipality: improve the effectiveness of air pollution detection and forecasting.
With the federal government: assess a new technology for a congressional science or technology committee. This would mean living in Washington, D.C. — a good place to learn about implementation effectiveness.

These are the examples of doctorates in public interest physics.

There are two questions one might ask about such doctorates. First are they better training than the traditional basic research physics doctorate? Second can one develop suitable evaluation criteria for successful performance in such doctorate work? I don't know the answers to these questions, but I think we should at least explore the idea. Incidently I don't think these should replace the traditional doctorate. Both types of doctorates should be offered; and certainly the public interest physics doctorate will be a relatively small program for a long time.