THE GRADUATE STUDENT

HOW DOES HE SEE HIMSELF?

Despite the usual grumbles about their courses and exams, the increasing length of the PhD course and poor student–faculty relations at some schools, most physics graduate students appear to be reasonably content with their lot.

WE START THIS STUDY of the graduate student, logically enough, with his own view of himself. Eight graduate students, representing schools from New Mexico to Cornell, tell us of their hopes and frustrations, their exams and research, their attitudes to national politics and campus administration. We learn of their motivation to physics and the reasons for their choice of a graduate school. In one case the wife of a contributor adds a comment of her own.

Our student contributors interviewed their colleagues with a list of questions supplied by PHYSICS TODAY, and the answers provided raw material for their articles. Points that were repeated in many of the contributions are summarized here; the graduate students speak for themselves in the pages that follow.

Marriage and children

Many graduate students today are married; in our sample the proportion varies from a fifth, at Northwestern University, to about two thirds at the University of Florida (where John Taube suspects that something in the water has induced a recent spate of marriages). About one quarter of the married students have at least one child, and in most cases their wives bring in the second income needed to raise a family.

Motivation and careers

Why did these graduate students choose physics as their PhD subject and probable career? Our contributors tell us that an honest interest in the subject for its own sake is the usual reason. James Slevin, of City College, City University of New York, says: "They have a genuine, often passionate, interest in physics itself. Debate initiated in the classroom often carries over to the cafeteria or student common room." John Taube, of the University of Florida, suspects that the fledgling physicists know they will not become rich; they chose physics as "the most basic of all the sciences." One of Bertle Hansen's colleagues at the University of New Mexico told him: "I chose physics for the challenge. It was the hardest subject I could find."

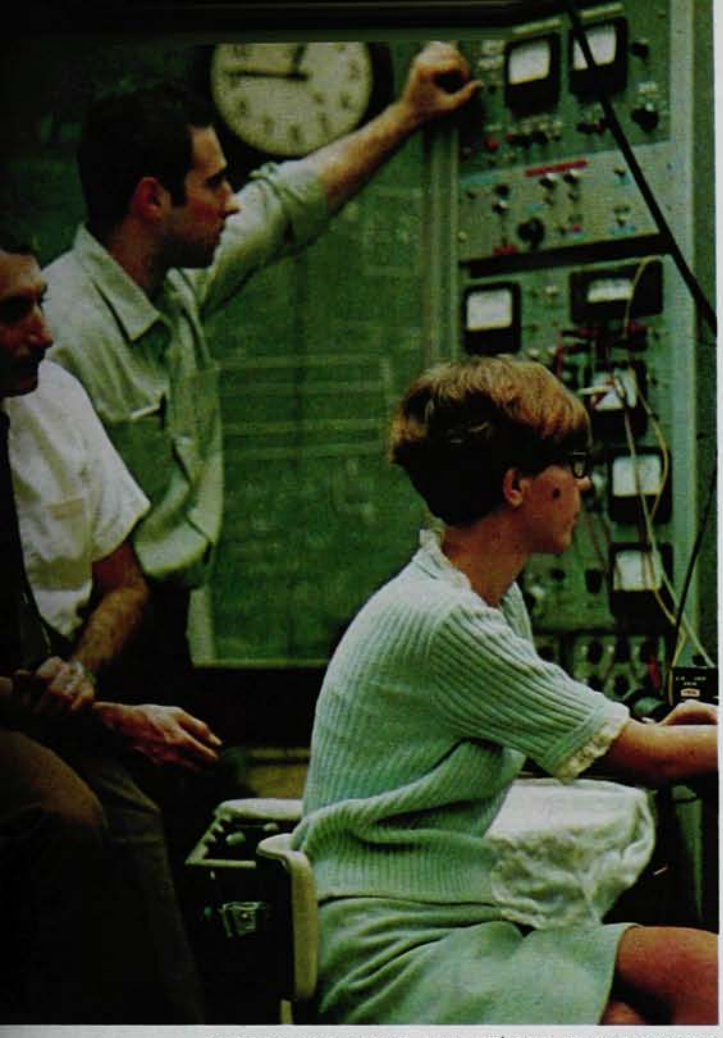
About 70% would like to make their careers as academic researchers, but they know they might have to settle for a job in industry – considerably lower on their self-imposed social scale. Hardly any want to become engineers, but 10 or 15% glumly accept the possibility. Allan Evans of Cornell says this is not a good time to be a graduate student: "Our reasons for entering graduate school a few years ago are no longer so valid."

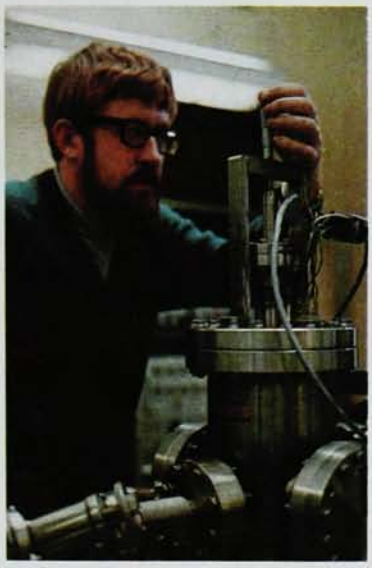
Professional societies

Hansen found that most New Mexico students "do not know why the American Institute of Physics exists, or even if it should." Samuel Fain told us that "few students are active in physics organizations, and they have no strong feelings about them." Although Allan Evans admits that "a good fraction" of the students at Cornell University belong to either the American Physical Society or the American Association of Physics Teachers, he tells us they have little to say about these groups. They view the AIP and the member societies primarily as journal publishers and meeting organizers. The general impression given by all our contributors is that the AIP is not as well known among physics students as it should be.

Politics and the draft

As might be expected, a wide range of opinion on political matters exists within physics departments, but "most students lean towards the liberal side of the political spectrum" (Taube). John Oberteuffer estimates that per-





PHOTOS TOP RIGHT AND BELOW: PHILIP ZACUTO

haps 80% of the students at Northwestern University classify themselves as liberals or independents. All our contributors claim that their friends have an avid interest in politics, although few have worked for a candidate or engaged in any other political activity. At the University of Florida the students, according to Taube, "hardly have time to express an opinion, let alone carry a picket sign."

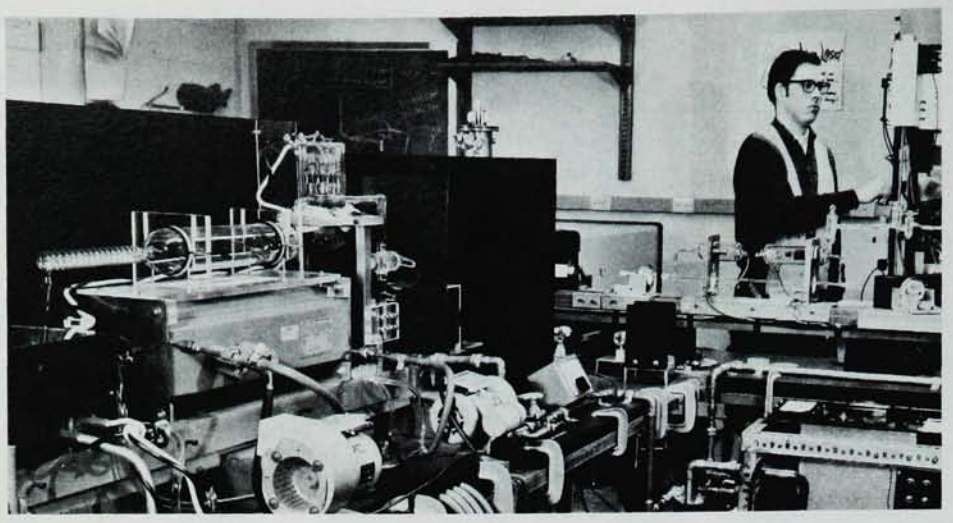
Physics graduate students have the expected low opinion of the new draft laws; they admit that the old arrangement was unfair, but the uncertainty of the present system appears to be no better. Taube claims that 1-A reclassification has turned more than one PhD candidate into an MS candidate.

Here are our eight reporters:

ALLAN R. EVANS Cornell University

Cornell has a rather distinctive approach towards graduate training in physics. First, it is not really one approach but several, because physics at Cornell involves a number of departments and interdepartmental laboratories. Second, the flexible degree requirements and unique "special-committee" structure allow the graduate student a full opportunity to explore the breadth of Cornell physics. Finally, most of our professors bring to their dual roles as teachers and researchers a remarkable attitude that benefits graduate students, faculty and research.

Physics at Cornell includes the Department of Physics, with its Laboratory of Nuclear Studies and Laboratory of Atomic and Solid State Physics, the Department of Applied Physics and the Department of Astronomy and Space Sciences, as well as the interdisciplinary Materials Science Center and Center for Radiophysics and Space Research. From the viewpoint of the student, compartmentalization of physics research is avoided by the flexible degree requirements and the system of interdepartmental laboratories, which, although mystifying to the uninitiated, benefit the student in his thesis work. More mystifying but also advantageous to the student is the distinction between a "Department" and a "Graduate Field." A Cornell



ALLAN R. EVANS graduated from the University of Illinois in 1965 with a BS in engineering physics. Currently in his fourth year of full-time graduate study at Cornell, he is a member of the physics student–faculty liaison committee.

graduate student is enrolled in a Graduate Field, the faculty of which usually consists of professors of the appropriate department and some professors from other departments. This distinction is another way in which traditional departmental barriers are made less restrictive.

Exams and committees

For my discussion of graduate training in physics at Cornell I will use specific examples from the Department of Physics. This restriction, which will avoid unnecessary confusion over small details, will not lead to serious distortions because departmental practices, degree requirements and conditions are sufficiently similar to the other departments.

An entering physics student is assigned to a special committee consisting of three professors chosen from different research specializations in his graduate field. The committee advises the student on courses and preparation for the required examinations. The student may change his committee by selecting members more compatible with his research interests, preferably before the beginning of his second year. This new committee has members representing major and minor subjects, and its chairman, as well as representing the major subject, is usually the thesis advisor.

Graduate students in physics are required to pass three examinations; they are the qualifying examination, the PhD candidacy examination and the final examination or thesis defense. The qualifying exam, usually taken at the beginning of the second year, determines the student's potential for doctorate work. Early in the third year the candidate will take the candidacy exam, which has a form determined almost entirely by the special committee. Each professor on the committee may require a written examination, with a length that can be anything from one hour to two weeks. An oral exam follows the written ones.

Admissions policy discourages students who seek only a master's degree, but those who fail the qualifier may be allowed to try for a master's thesis instead of the PhD. Also a master's degree without thesis may now be granted after the PhD candidacy exam.

Largest teaching instrument

The 10-GeV electron synchrotron in the Laboratory of Nuclear Studies (PHYSICS TODAY, October, page 29) has been called the largest instrument for teaching on any campus. A part of the philosophy underlying the development of this and earlier accelerators at Cornell has been that equipment for research is also equipment for the training of graduate students, and that students should become involved in the experimental details of the apparatus that produces the data.

Most graduate students choose Cornell primarily for its excellence in research. The diversity and balance of the various research fields, together with the flexible degree requirements, allow a wide variety of thesis topics; the decision among them can be made after entering graduate school rather than before. Those involved in widely different fields of research enjoy relatively close communication here, and faculty–student relations are good. Our real problem is the change in the profession during the last few years.

* * *

During this project I have had useful discussions with many people; L. G. Parratt, B. D. McDaniel and W.W. Webb have been particularly helpful.

JOHN TAUBE University of Florida

The root-mean-square graduate student in physics at the University of Florida is male, 24 years old, has been married for two years but has no children. His wife works as a teacher and he drives a 1965-model car. He came from a family of 2.5 children. His father earned $8000–9000 a year, and his mother worked at least part of the time, while he was growing up. He decided to go into physics because he liked science, and physics is the most basic of the sciences. He came to the University of Florida because it is a good school and it made him the best offer. He plans to complete a PhD degree and then go into teaching with research.

Marriage and entropy

Two thirds of the 110 graduate students in the department of physics and astronomy here are married – 60% of these were married before they entered graduate school. The most popular time to get married is apparently just before starting graduate work, or within a year afterward; this period around the transition from undergraduate school appears to be some sort of turning point in a man's life, when he has chosen a career and has his plans laid at least for the near future. At one time last year the number of marriages here became so noticeable that people began suspecting that there was something in the water at the physics building.

I was a single graduate student for

JOHN TAUBE was born in Latvia and came to the US, by way of Germany, at the age of five. He took his BS at the University of Nebraska, with a double major in physics and mathematics, and is now in his third year of graduate school.

one year, and now I have been married for another year; so I have experienced both worlds. There is an amazing difference in one's work habits between the two. A friend described it very succinctly by saying that there was an enormous decrease in his entropy when he got married. (Is marriage an irreversible process?) Married life is much more ordered; you get up and go to bed at regular times, eat three meals a day, and arrange your time with the car to coincide with your wife's activities. The single graduate student eats when he is hungry, sleeps when he is tired and works only when the spirit moves him. My own marriage has made me steadier and more conscientious than when I was single, and my grades have improved.

Finances and backgrounds

Although the graduate student's paycheck may not be large enough to keep a family on, it becomes a very nice second income. For example, a teacher in this area can expect to earn \$5000–7000 a year. Adding her husband's \$2500 we arrive at an annual income of \$7500–9500.

The single beginning graduate student has to make do on the \$2500 a year that the university pays him. He probably gets together with three others, and they will rent an apartment for \$150–200 a month. 93% of our graduate students own cars, 75% of them less than five years old. A surprising 15% have new cars.

Our physics graduate students come from a wide variety of backgrounds. Fathers' occupations range from banker to unskilled laborer, with incomes from \$3000 to \$20 000. The most common father's occupation is engineer; only one is a scientist (forgive me, engineers), and none are physicists. Most students' fathers have had some college education, and in general their mothers completed high school. On the average the mother had slightly less education than the father.

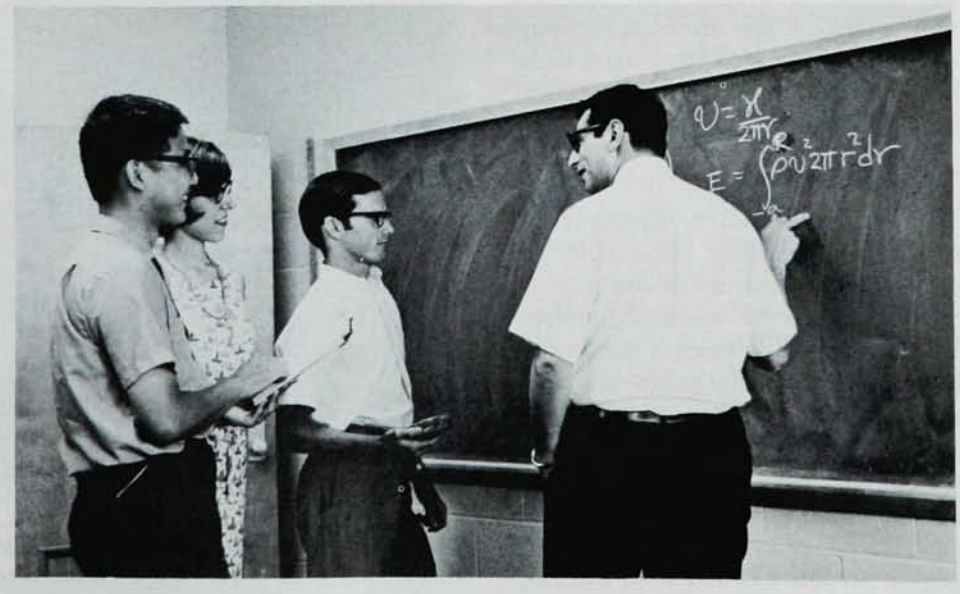
Why physics?

Most students here chose physics because they are scientifically oriented and have realized that physics is the most fundamental science. They all knew that the courses would be difficult, but I think that, rather than frighten them, this difficulty served to challenge the students.

I doubt very seriously that anyone takes up physics with the idea of becoming rich, but they do expect a job that will provide them with a comfortable living. Many feel that a PhD in physics is one of the best union cards you can carry. I know of no student with a "burning compulsion" to be a physicist; most of them enjoy the subject but very few are addicted so seriously that the withdrawal symptoms would be other than mild. Quite a few started as mathematicians, engineers or chemists and switched to physics later. They would all like to contribute something to that great body of knowledge that is physics, but very few feel the burning passion to unify physics, or something equally spectacular.

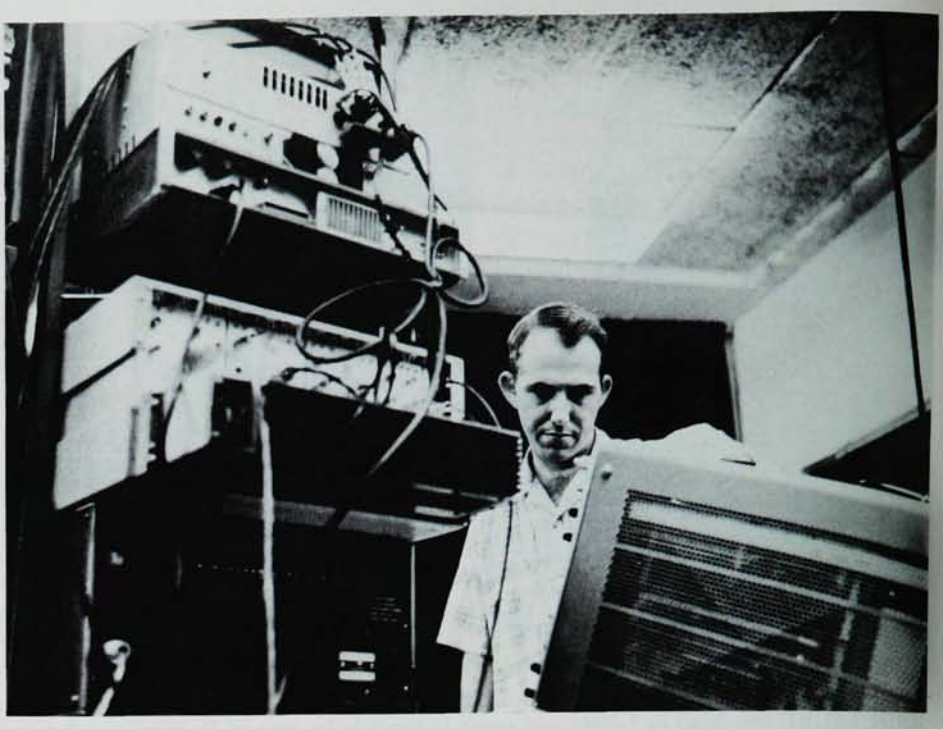
This department is of a good size, is young and improving, and has a few very outstanding people. Nevertheless most of our graduate students came here merely because the offer was the best they had received. Surprisingly few told me that the climate had any effect on their choice, but I suspect it had more than a little to do with their initial interest.

Physics students, like everyone else, love to complain, and the complaints here relate to professors, courses and examinations. Most students admit that examinations stimulate their work, but most will also say that, as a measure of progress, they rarely succeed. All too rare is the professor who will take the time to make up and grade a mean-



ingful examination – and it does take a lot of time to do it properly.

It is not a bad life, this graduate study. It offers challenge and lots of hard work. The rewards are not very tangible, but there are some. If I had to do it all over again I would be back trying to solve the spherically symmetric square well – all five different ways.



MARY TAUBE

What about the girls who become physicists? Most of the ones I knew in college started out as potential math majors. Their switch to physics came about when they became interested in the material and found out that they *could* do the work. Physics course work is theoretical enough that a girl can hold her own without having built herself a hot rod in high school, but I had taken several physics courses before I finally lost the implication of motors and machines.

I met John in graduate school, and we were married at the end of our first year. I think many female physicists marry men in physics or closely related fields; my own reason, and perhaps that of many of the others, is that I needed a husband who could understand my total involvement with the subject or with a project.

Now that I have my master's degree and am teaching at the local Junior College, I find that our common physics background is useful for us both; we can share experience in our separate jobs because each of us understands the same material.

MICHAEL J. SMITH Howard University

Physics graduate students at Howard University are disappointed that they are not given a larger share of the responsibility for running the department. They take six years, on the average, over their PhD and do enough of the teaching and research chores, they feel, to entitle them to a voice that will be heard by the administration.

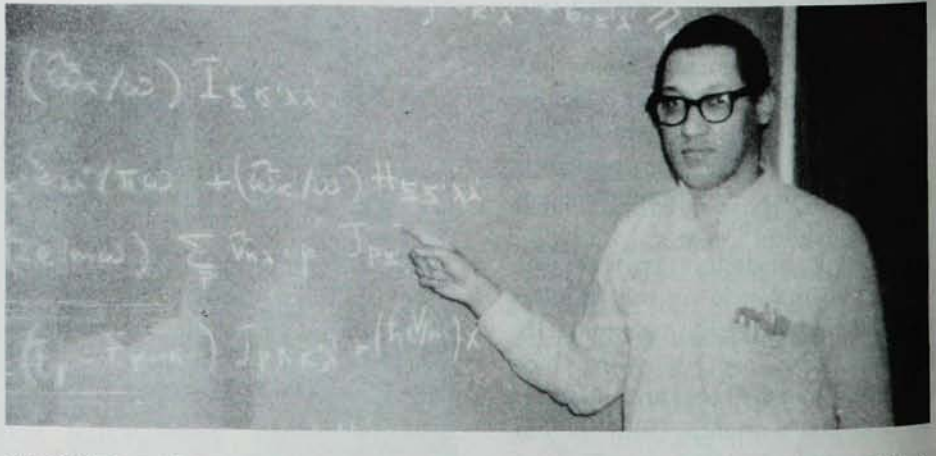
About 10% of our graduate students were Howard undergraduates; most of the others came here from southern universities. A few are from northern universities, and we have a small number of foreign students (from Africa, India, Taiwan and Guyana).

Voiceless workhorses

They find themselves, during their six-year stay, largely responsible for undergraduate instruction and used as the workhorses of research projects. Yet they have little voice in the formulation of departmental policy and none at all in the design of curricula. Of the many roles that a physics graduate student assumes, teaching is perhaps the most sensitive and crucial. We think the department should make time to give us some instruction for this job; perhaps a short course in teaching methods would be effective.

Faculty–student relations could also be improved. At present the only informal meeting we have with the faculty is the coffee hour before the weekly seminars. Perhaps if we met informally more often our suggestions (or complaints!) would be heard.

We feel cut off from society, too, just as we are from the department. Graduate students here find that they have no time for the everyday problems of the outside world if they are to keep up with their PhD program. It is significant, perhaps, that in this black university very few graduate students take any active part in political matters or in the power struggles that have overtaken this city recently. Would it be good to institute a program that periodically interrupts graduate training for short intervals, so that we can keep acquainted with those human problems we would otherwise ignore?



MICHAEL J. SMITH has an SB from MIT and an MS from Drexel Institute of Technology; his work at Howard is on the theory of fully ionized plasmas.

SAMUEL C. FAIN JR University of Illinois

The origins of graduate students at Illinois are quite diverse. Students come here from Princeton, Harvard and Berkeley as well as from small colleges that send few students on to graduate school. A student may come here because of the outstanding reputation in certain research fields, or may not even be aware of the reputation. He may have come because financial aid was offered, or this may be the school nearest to his fiancée. His decision to study physics may have been made in high school or at the last possible moment in college.

Teaching

Most entering students divide their time between teaching and taking courses. Graduate students are needed to handle recitation and laboratory sections for the 2000 undergraduate students enrolled here in introductory physics courses, and the teaching assistant can find this part of his work satisfying. He can sympathize with his students because in his own courses there are also crowded lectures with little time for questions, and he is in an excellent position to help them. Having fewer students to deal with, he can give them more individual attention than the professor in charge of the course does. In a recent course evaluation by undergraduates, many graduate assistants in introductory courses were more highly rated than the faculty.

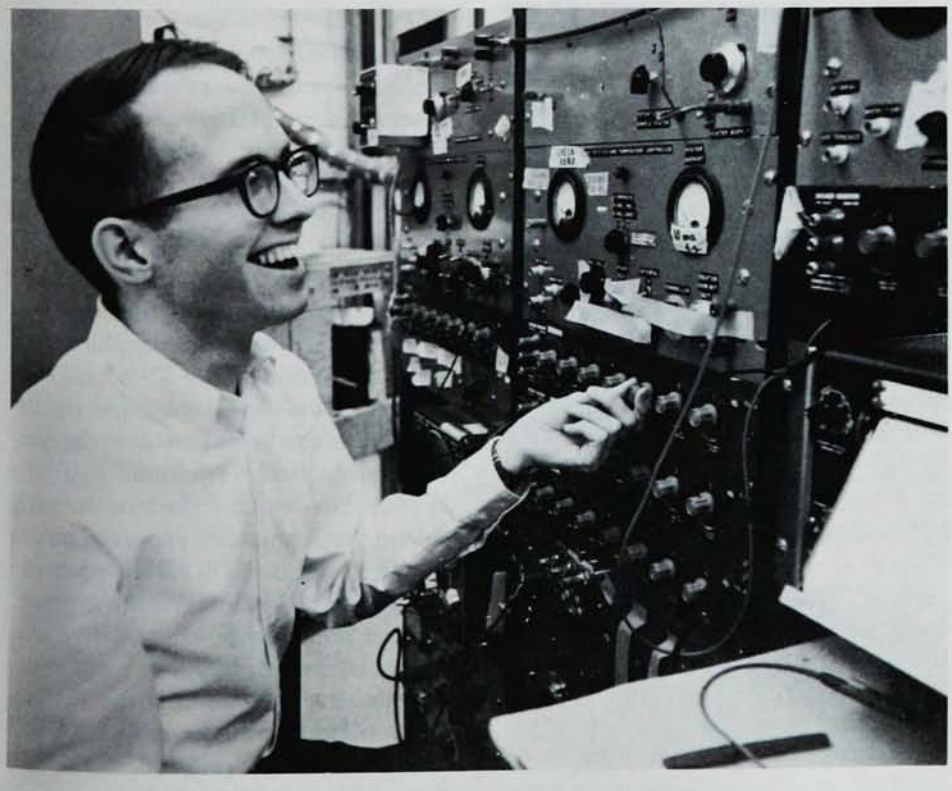
On the other hand, few graduate students are terribly excited about most of the courses they take themselves. There is little opportunity for direct faculty contact, and most of the discussion of lectures and problems is with other graduate students. Some graduate-course teachers, however, are outstanding, and a group of students recently initiated an award in response to the excellent courses given by one faculty member.

The qualifier

The most important examination at Illinois is the "qualifier." Perhaps half of the entering students get past this hurdle, and most of these go on to complete the work for their PhD. Some students leave in mortal fear of the exam without taking it; others take it the two allowed times, and still others simply lose interest in physics. It is not necessary to pass the qualifier to take the MS, so most students who leave do so with their master's degree.

The student who has passed the qualifier and most of his courses faces the problem of choosing a research advisor so that he can get started on research, the real business of graduate school. With the wide variety of research specialities and of personalities the student faces a bewildering choice. His decision is a very personal matter because someone who would be a good advisor for one student might not be for another, but somehow a choice is made, and most students (but certainly not all) stick to their original choices.

In research the student is more or less on his own to work out details and in some cases to plan his project. Advisors are generally interested in their students' welfare and see their students periodically, but the many roles a university professor must play do not leave much time to train students in tech-



SAMUEL C. FAIN Jr's undergraduate education was at the University of Tennessee and Reed College, where he switched from engineering to physics. He hopes to finish his PhD experiment on solid helium this fall.

niques. Books, other students, postdocs and a generous portion of trial and error are the teachers.

No time for fundamentals

Perhaps the most important problem is the lack of confidence many students feel about their own work. At this time the student rarely feels that he can answer important questions or compete with the experts in his field, although that is what he may have expected to do. One student told me that he had entered physics because he thought it tried to answer fundamental questions, but he found that there was no time for that. Another commented that the great expectations of entering graduate students are matched only by their naïveté!

Most students are quite satisfied with the administration of the department. It is sympathetic to such graduate-student problems as the length of time needed to obtain a PhD in physics. Some requirements have been changed so that graduate students can get on with their research sooner; the language and minor-subject requirements have been dropped, and a new style of preliminary examination more closely related to research has been instituted.

Students have no official voice in department affairs, but their opinions can be heard by the present head and associate head. To improve student–faculty relations, a daily coffee hour has been instituted for those who want to take advantage of it.

BERTLE D. HANSEN III — University of New Mexico

Most of my comments concerning the University of New Mexico physics and astronomy department arose, during conversations with my fellow graduate students, as answers to my questions: "Why did you come to New Mexico?" and "What changes would you like to see in the department?"

We have 18 physics and astronomy faculty members and only 31 full-time graduate students. This student–teacher ratio is very good, of course, but we think that the small overall size of the department helps us too.

". . . you need to know at least 90% of the students and faculty in a department for true interaction . . . if there are more than 50 people this isn't possible. For example, after only one semester here at UNM I knew three professors who could write letters of recommendation for me. After three years at Cornell I had difficulty in finding three professors who knew me."

Two main examinations are given. They are the qualifying examination, designed to measure ability, thought processes and fundamental understanding, and the comprehensive examination, which tests advanced knowledge.

"I liked the listed curriculum, the research being done, and I was impressed by the personal letter I received from the chairman. The department came across to me as part of a friendly, personable school where I could get a good education."

"I wanted a good, solid, general background; I wanted to use it, and still be able to specialize enough to get out. I'm getting what I wanted."

"The great quantities of homework at the two other schools I attended seemed unnecessary and created much too much pressure. It's just right at UNM."

Not everyone is satisfied, of course; one student told me that he thinks the level of some of the courses is too low, and that he has to learn his "real" physics independently. Another said:

"We have the backbone classes, that is, mechanics, electrodynamics, quantum mechanics and so on. All the others appear to be just thrown in."

The PhD Game

Most graduate students here find themselves playing two roles. The first is that of learning the basics of physics and training to become physicists themselves. Some discontent exists about this role but in general most of us think it is fulfilled fairly well. The second role is that of "playing the PhD game," a game that is demanded by the university administrations and the physics departments in the entire US educational system. A lot of the rules and regulations are felt to be secondary to the educational process. "Tradition" and "the system has worked before so why should we change it?" appear to be the governing standards. High-pressure course work, the sink-or-swim attitude, passing a language exam before you can start research officially, passing the comprehensive exam to prove that you have memorized a mass of details when you have already proved your ability; these and many other rules and situation appear to have a questionable position in your preparation for a career as

BERTLE D. HANSEN III received his BS in physics from Weber State College, Utah, in 1966 and his MS from the University of New Mexico in 1968. He has been president of the UNM chapter of the Society of Physics Students for two years.

a professional physicist.

"How do I see myself as a physics graduate student? I'm paying my dues! I'll play the game until I get my degree, and then I can get out of it."

Teaching without research

Nearly all of us enjoy our research, discounting the moments of boredom and redundant labor involved at times. For the future, most of us look forward to more research and consider it to be a fundamental activity of a good physicist. But one student who is not interested in research made this point:

"My position is that of an observer to active physics. I want to understand and be aware of what is going on, but take no active part in the research aspects. I want to teach – to be an interpreter of physics – primarily to nonscientists. Physics as it is taught now is just dull problem solving; it is boring and terrible. This isn't physics at all, but it has taken me five years to find out that it isn't. Physics training is oriented totally towards research, in spite of the people who say that teaching is given just as much emphasis. Physics teachers in general are notoriously bad, with a few good ones springing up randomly. You don't have to be a Nobel-prize winner to be a good teacher. Surely there's a place for someone who just wants to teach and interpret physics? At present I am, essentially, punished if I express a greater interest in teaching than in research."

JAMES SLEVIN City College, CUNY

The graduate student at City College finds himself in an enviable position. He cannot claim the advantages of a student at Rockefeller University, where faculty members outnumber students three to one, but the almost equal number of students and faculty at City assures him of ample attention. Classes are small, often numbering only three or four and rarely more than ten. The student finds it easy to consult his teacher, often in the informal atmosphere of the cafeteria. And he is at a college with an imposing tradition.

City College is the leading baccalaureate source of PhD's in the US, although it ranks only 40th in the size of its matriculated undergraduate student body. A recent survey by the American Institute of Physics showed the college to be the nation's second largest source of students who go on to do graduate work in physics. Massachusetts Institute of Technology was first.

Our alumni include Bernard Baruch, Felix Frankfurter, Upton Sinclair, Lewis Mumford and Jonas Salk. The physics department alone can claim two Nobel laureates, Robert Hofstadter and Julian Schwinger, and a long list of distinguished American physicists.

Politics, programs and exams

City College has long been known for its involvement with the political, social and economic problems of the community and the country. During the 1920's and 30's it had a reputation for being a hotbed of political activism. After the relatively quiet years of the 1940's and 50's, left-wing elements, still fairly small in numbers, are again very active and vociferous.

The physics department fits well into the current picture of City College. It is characterized by a spirit of youthful individualism and enthusiasm. Some of its members, both students and faculty, play a very active role in the political and social life of the campus and have been embroiled in recent student controversies.

We have had a master's-degree program in physics here since 1961 and a

JAMES SLEVIN has a BSc and an MSc from Queen's University, Belfast. He came to the US in 1964, worked in industry for two years, and then entered City College where his work is on atomic physics.

physics-PhD program since 1964; currently 58 students are enrolled in graduate courses. Most students are satisfied with the presentation, content and organization of the courses, and some who have come from other schools or who have taken courses elsewhere find that the standards are high. The qualifying examination, nightmare of all graduate students, is as difficult at City as at some of the longer established and better known schools, and the attrition rate is high.

All students take an additional examination, designed to prepare them for thesis work. The student is subjected to a rigorous two-hour grilling in which he has to demonstrate some knowledge of his chosen field and an ability to carry through a thesis program. The committee that supervises this examination consists of faculty members working in the student's own field and an eminent physicist from another institution who attends to make sure that City College's relatively new program conforms to those of more established schools.

I and several others have passed this stage, and almost without exception we found it to be a rewarding and worthwhile experience. The test compels the student to obtain a wide knowledge of his field; particularly for an experimentalist it ensures that he knows something of the theory before he embarks on what often turns out to be a 90%-plumbing and 10%-physics exercise.

Student–faculty relations at City College are constantly improving. On the initiative of our active and popular chairman, Harry Lustig, a graduate-student committee was recently formed to give students an opportunity to air their views and register complaints, and to involve them in some of the decisions of the graduate program. Participatory democracy is evidently becoming a reality in the physics department.

JOHN R. POWERS University of Pennsylvania

The typical physics graduate student at the University of Pennsylvania works more than six years on his doctorate. According to the classical concept of the degree, in this period he is supposed to have mastered his field well enough to make a significant and original contribution to it. A survey of my fellow students has led me to the conclusion that the lack of detailed clarity in this concept has created many problems that could have been avoided. We feel that there is a need to reconsider the formal degree requirements.

JOHN R. POWERS attended Princeton Theological Seminary after graduating at Columbia with a physics major, and is a minister of the United Presbyterian Church. He returned to physics in 1966 as a graduate student at Pennsylvania.

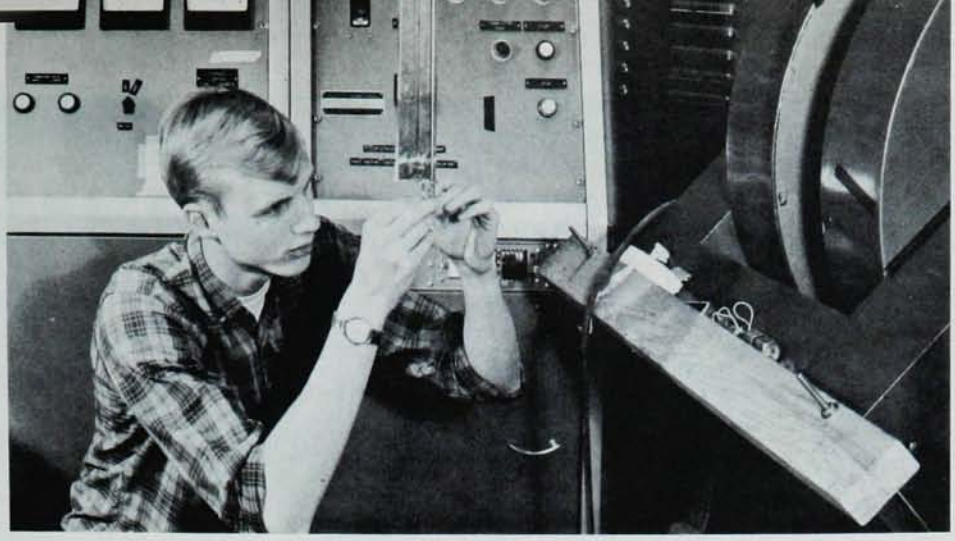
In his graduate program a student finds an interrelation among the significance of his thesis project, the independence or originality of his personal contribution to it, and the time required to complete it. There are ways of varying the relative weights of these three elements. We could desire greater or lesser advisor involvement. The PhD could be awarded for four years' work, say, on a very long project. It would even be possible to think of the whole program as professional training, similar to that leading to the medical degree.

However, any action that is taken should depend upon the overall goals of the degree program. Because these differ slightly in individual areas (for example, high-energy experimental physics) it is suggested that each area be given greater autonomy in setting the formal requirements for the PhD degree.

In both theoretical and experimental programs, the student must master an ever-expanding set of technical skills, which the experimentalist learns while doing the many routine chores associ-

ated with his field. By having each area set the formal requirements, these activities would have to be examined for their educational value.

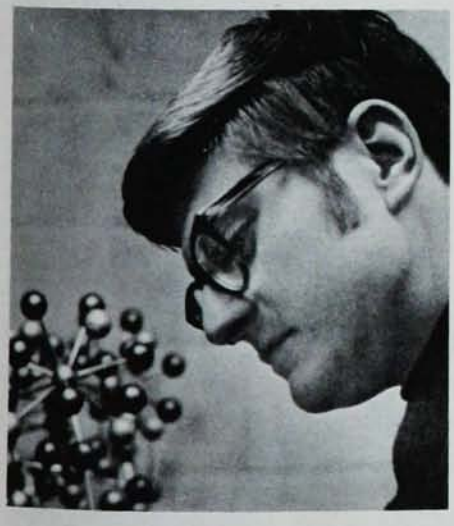
This shift in autonomy would allow the student, in consultation with the entire faculty in his area, greater flexibility. His program should be related to his future professional goals and should be designed to realize his creative potential. Perhaps this idea would be too bureaucratic to work, yet the advantages appear to be worth the risk.



JOHN OBERTEUFFER Northwestern University

Northwestern University has separate departments of physics and astronomy, with a faculty of 11 and 15 graduate students in astronomy and a faculty of 32 with 70 graduate students in physics. The two departments are similarly organized. Under a plan initiated last year, all graduate students will do some teaching during their first few years, regardless of the source of their support; this system lessens the teaching load for first-year students and affords all students the experience of some teaching.

Most students begin their dissertation-oriented research after the first year, and general enthusiasm for research shows in their career preferences. Over 70% hope to work in a university, government or industrial research laboratory. This enthusiasm is accompanied by very positive attitudes towards physics and the students' own research. No one has told me of a "burning urge" to do physics, but one student quoted Richard Feynman's words: "If anything else were more fun then I'd be doing it." Little cynicism about physics is apparent; it appears rather that graduate students have a somewhat inflated feeling about the physics profession. They feel that the public regards physics as "powerful, difficult and obscure," with practitioners who are "very intelligent, usually logical but often narrow, rarely modest and never compassionate." Most students credit physicists with very high intelligence and feel that, contrary to the stereotype, physicists are politically aware.



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Opinions on administration

When asked their reason for choosing Northwestern University as their graduate school, most students gave the offer of financial support. Other reasons given included recommendation by an advisor and the proximity of Chicago. Now that they are here, they have no strong opinions about overall university administration but some dissatisfaction in certain areas is evident; there are the usual complaints about housing for single graduate students and the quality of the institutional food.

On the other hand, there is general approval of the administration of the physics department. It is a department in transition, increasing the number of graduate students, faculty, and the general level of activity. A new chairman, Arthur J. Freeman, has brought the graduate students more fully into the department and involved them in activities beyond their own research. Research facilities and faculty are considered to be good. The only common criticisms are about study environment (many first-year students are assigned desks in one large room) and some lack of faculty–student contact. In general, students doing dissertation research are satisfied with their advisor's help in professional matters, such as employment advice, but there is some feeling that personal contacts and encouragements are not as strong as they might be.

Lack of involvement

Only about 40% of Northwestern's older graduate students in physics are members of the American Physical Society, and among that number none are involved in APS affairs beyond having given one or two ten-minute papers. For example the questions raised by the Schwartz amendment, and extensively discussed in PHYSICS TODAY, were barely mentioned in conversations among graduate students. This lack of involvement by graduate students in APS activities appears to be consistent with the very limited contact that graduate students make with the physics profession. Few have much knowledge of the various interactions among physicists and between physicists and their patrons. Perhaps one in twenty has read a grant proposal before graduating.

Graduate study in physics is tough, rewarding, boring and exhilarating at various times. It is for the most part a long process – often six years. A certain resignation to the incongruities of this activity is apparent; to be making $4600 per year but have more education than 99% of the labor force, and to be aged 27 but still be a student, are serious discomforts. They are tolerated, however, because physics is inherently exciting and rewarding both in theory and practice. □