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ABSTRACT

Recent developments in graduate programs are discussed in 15 papers from a 1982 conference cosponsored by the Council of Graduate Schools and the Graduate Record Examinations Board. Attention is directed to issues associated with program presentations, program innovations in various disciplines, and industry/university cooperative graduate programs. Papers and authors include the following: "Opportunity and Impediment in Graduate Program Innovation" (Paul A. Albrecht); "Defining 'Innovative Graduate Programs'" (James B. Bartoo); "Innovations in Biological Sciences, Industry and Engineering" (Don H. Blount); "Innovations in Education/Cooperative Education/Continuing Education" (Mary Ann Carroll); "Innovations in the Social Sciences" (Averett S. Tombes); "Innovation in Graduate Education: The Issue of Quality" (Lewis C. Solmon); "Admission Criteria for Mid-Career Students: New Dimensions for the GREs" (Bernard V. Khoury); "Progress in the Midst of Poverty" (James Olson); "University/Industry Research Relationships: Myths, Realities, and Potentials: 14th Annual Report of the National Science Board" (Carlos E. Kruytbosch); "The View from Academia" (Kenneth H. Keller); "The View from Industry" (David L. Dotlich); and "The Industrial Affiliate Program" (James C. Seferis). (SW)

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Council of Graduate Schools in the United States

Proceedings of
Conference/Workshop

Recent Developments in Graduate Programs

New Opportunities Through Versatility: Broadening the Mold

October 13, 1982

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American Council on Education

Hyatt Regency Hotel
Minneapolis, Minnesota

Recent Developments in Graduate Programs

New Opportunities Through Versatility: Broadening the Mold

Council of Graduate Schools in the U.S. and The Graduate Record Examinations Board

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RECEPTION AND DINNER

Introduction

Michael J. Pelczar, Jr., President
Council of Graduate Schools in the U S

Ten years ago The Council of Graduate Schools, in collaboration with The Graduate Record Examinations Board, established a panel on the subject of *Alternative Approaches to Graduate Education*. The charge to the panel was "to examine graduate education with respect to *what it is and what it could be*, taking into consideration the need to respond to changing social circumstances." The report of this panel was published in 1973 under the title "*Scholarship for Society*."

From an historical perspective the Panel observed that:

> "Graduate schools in particular possess at this moment central positions and obligations in addition to the original duties of advanced institutes namely the preservation of traditional knowledge and the advancement of learned disciplines. Three requirements for meeting the obligations, new and old, are the following: 1) awareness among academic men and women of fundamental directions of American society; 2) readiness among faculties and administrations to criticize their own self-conceptions in light of historical shifts in the place of the learned professions in the general life; and 3) an appropriate philosophy of change, alert to human hope as well as to human needs."

Today, ten years after this was written, it bears repeating and with greater emphasis!

The panel identified several problem areas which were characterized by these broad headings:

1. Mission of graduate institutions
2. Access
3. Nonacademic experience as a resource for learning and teaching
4. Alienation in student/faculty community relations
5. The reward system
6. New educational technology
7. New conception of subject matter
8. Insuring viable futures

For each of these problem areas the panel suggested specific recommendations and added suggestions for implementation.

On the topic of curricula and careers the panel commented as follows:

"The order and procedure of advanced study in every discipline will be related not alone to the inner structure of the discipline but to other considerations as well. One consideration will be whether the student is enrolling for the purpose of self-development or to prepare for a particular professional career or career change; another consideration will be whether the function of the institution offering the courses is primarily the advancement of the discipline itself through research and experiment or that of training working professionals and paraprofessionals. Emphasis on whole problems will become a norm. Thus, ecological studies will combine work in the humanities, social sciences, natural sciences, and engineering, on the assumption that the attack on pollution requires attention not only to particles in exhausts but to drivers—their myths, instilled values, and aspirations.

"Curricula will also reflect the view that cross-disciplinary studies are instruments for the creation of careers capable of meeting new social needs. Thus, interdisciplinary work in fine arts and urban studies will prepare curators whose management of urban cultural resources is in touch with community realities. Interdisciplinary work in the arts and in medical science will prepare instructors in both cultures to interact effectively in training programs that analyze physiological-psychological response. In general there will be an unremitting, although not intimidating challenge to the more restrictive, exclusionary features of disciplinary cultures; the challenge will be laid down partly on the ground that existing social problems cannot be met except through unprecedented combinations of bodies of knowledge and partly because the genuine points of connection among the disciplines deserve exploration for their own intrinsic interest. The content of advanced education from discipline to discipline will, however, change less than the forms. The primary change will come from the emphasis on the public uses of knowledge."

In many ways this meeting today is a follow-up to the panel study to which I have referred. And so it is appropriate to raise the question "Where is graduate education today as compared to where it was ten years ago? Here are a few statistics.

Changes in enrollments and degrees awarded:

	1970–1971	1980–1981
◦ Enrollments (NCES):		
Graduate	1,031,000	1,343,000
◦ Earned Degrees:		
Masters	231,000	298,000
Men	138,000	148,000
Women	92,000	150,000
Doctorates	32,000	33,000
Men	28,000	23,000
Women	5,000	10,000
◦ Foreign Students:		
Graduate & Undergraduate	150,000 (approx.)	312,000
◦ Financial assistance for graduate students: fellowships and traineeships	50,000 (approx.)	5,500 (approx.)
◦ Employment Prospects: Percentage of science and engineering doctorates who indicated academic employment	60%	43%

This last statistic—namely the shift of employment opportunities outside of academia raises the question: "To what extent have graduate programs changed to accommodate the new circumstances?"

To get some answers we queried the CGS deans as to the new programs introduced at their institutions. We asked them to give us the following information about their "new" programs:

1. Title of "new" program:
2. Brief description of program with emphasis upon its innovative features:

3. Which group (faculty/students/administrators/alumni/community/etc.) provided initial impetus for this "new" program?
4. What issues developed as a result of offering this "new" program? (e.g. quality, faculty and/or community attitude, etc.)
5. Has this program replaced an "older" program? If so, explain.

Approximately 100 CGS member institutions responded to the questionnaire. The information provided ranged from simply the title of new programs to detailed descriptions. The subject material of new programs covered a broad spectrum of disciplines, e.g. humanities, urban studies, policy studies, environmental studies, public history, language-business, and others. For purposes of this conference/workshop we have attempted to arrange these new programs into four broad categories, namely:

1. A definition of innovative graduate programs
2. Education, cooperative education and continuing education programs
3. Biological sciences, industry, engineering and areas of their interaction
4. Social sciences programs

The agenda for the conference/workshop is tightly structured. This was done deliberately so as to get the most out of a one-day session.

Our goals might be summarized in the following manner:

- To identify and elaborate upon the concepts associated with the development and implementation of new graduate programs
- To share experiences of problems and successes associated with new programs
- To use this conference/workshop for more effective articulation of the changes taking place in graduate education.

Program Presentations

Opportunity and Impediment in Graduate Program Innovation

Paul A. Albrecht, Executive Vice President
Claremont University Center and
Executive Dean
Claremont Graduate School

These are, to paraphrase, both the worst of times and the best of times to talk about graduate program innovation. The reasons why these are the worst of times are so obvious as to merit little comment. Certainly key is the great shortage of money and the shrinking of resources from stable or declining enrollments and from a variety of general economic causes. This state of affairs typically generates an almost overwhelming emphasis on the strategy of solidifying programs to contain the erosion of quality and on allocating resources to meet prior commitments—notably to tenured faculty. State regulatory agencies are by and large strongly on the side of solidification, notably in the context of perceived university impotence in faculty and staff reallocation or reduction. All of this is indicated by the numbing frequency with which the word "retrenchment" appears in articles on higher education.

The reasons why these might in some ways be the best of times are perhaps not quite so obvious. They involve in general a combination of the rather dramatic changes in educational needs and opportunities and the fact that trouble is the primary initiating stimulus for organizational change—the uses of adversity.

This conference, then, is deliberately and by design counter-trend and counter-intuitive, although I won't go so far as to say counter-culture. Its framers felt that it was time to take another view, which in no sense is to recommend avoiding entirely the strategy of retrenchment.

A few definitional and boundary questions need to be considered first. This is a workshop primarily on graduate *education*. Research is an integral part of graduate education but it will not be the primary focus here, in part because research has far fewer problems with innovation. When one does con-

sider graduate education: a difficult question arises as to whether so-called professional post-baccalaureate components should be excluded in favor of a focus on education in the graduate arts and sciences. The peculiar and increasingly non-rational way in which university organization separates these areas leads in that direction. Curiously, these separations are not nearly so clear in established smaller institutions or in emerging/institutions of varying sizes. Perhaps such institutions are in some ways more attuned to the future.

I propose to emphasize graduate education in the arts and sciences but not to exclude the professional area, in part because some of the opportunities and solutions lie there. Highly defined and specific professional education, such as in medicine, are less related to education in the graduate arts and sciences. But some other so-called professional areas such as business, education and even law are not as different in objectives, values and methods from arts and sciences education as to our detriment we have led ourselves to believe.

A final boundary consideration is that our concern, and the concern of this paper, is with *graduate* rather than undergraduate endeavors. Far too frequently we lump these two areas together under "higher education," thereby obscuring our analysis. While they are sequentially linked, and organizationally linked, there is no more necessary connection between graduate and undergraduate education than there is between undergraduate and secondary education.

For example, undergraduate education, notably in the excellent form with a heavy liberal arts component, is much more bound up with fundamentals than is graduate education, which is much more involved with frontiers and specialization. Retrenchment and the avoidance of undue proliferation may work very well in the undergraduate area and may in fact be a simplifying and clarifying strategy in terms of educational content and objectives quite apart from financial pressures.

But retrenchment may have a very different meaning at the graduate level where education must be much more responsive to new ideas, subject matters and careers. To fall back to prior essentials may be to miss opportunities, to fail to meet

needs—in effect to try to move forward merely by fine-tuning the past. This, in business, is called the buggy-whip or horse-collar strategy. To be a little less divisive, what we need to do is to ascertain in what ways undergraduate and graduate education are alike and in what ways they are different to develop a properly differentiated overall university strategy.

Why, then, is this a time of significant opportunity and need in graduate education for those who can manage some innovation and change? One could be somewhat frivolous and note that when investing in the stock market, it is always best to buy just before others see the opportunities—which often means being counter-trend. Of course, if there is subsequently no new trend, one is in the soup. In prediction about education, however, there are demographic data and knowledge about developments which hedge our bets.

It is important in all this to note that not only do new programs have costs, but *not* developing new programs also entails costs—what economists call "opportunity costs," the costs of opportunities foregone. A physician once commented: "Why is it that when people are ill they always talk about what they have eaten, never about what they haven't eaten?"

It is clear, for example, that merely to continue to do what we have always done, even to do better what we have always done, is to shrink and to become increasingly out of date. Those emphasizing the quality strategy for survival speak well to issues such as the importance of value added and received, the respect of society for a service, and competitive survival in a traditional pool in a difficult time. But they do not speak well, typically, to meeting new needs and to the enlargement of vision and function. In and of themselves, the quality concerns as they are usually expressed currently in graduate education are truncated. They almost always have a backward look—doing better what we are already doing.

The opportunities which should entice us, invigorate and stimulate us, have fundamentally two dimensions: 1) those stemming from the continuing explosion of knowledge which creates new educational needs and careers and 2)

those arising from new populations seeking and needing graduate education. Inevitably, these dimensions are somewhat intertwined.

One example of new opportunities and needs is the fact that careers for graduates of advanced study in the arts and sciences will lie increasingly outside of academe. In addition to placing heavy burdens of adaptation on the graduates themselves, this fact makes some of their conventional graduate education seem unnecessary or obsolete. Some of it is, for those who will not find university or other research careers. And some other things are lacking in their graduate education.

Furthermore, to shrink back to that small number for whom many current programs are adapted, deprives society of portions of such education which would be valuable and threatens even the remaining smaller base itself. This is, of course, startingly evident in the humanities in which the whole edifice, so long based on preparing persons almost exclusively for academic careers, is in danger. Mere participation in support of general education in the liberal arts at the beginning undergraduate level will not sustain it.

The opportunity then, is to explore whether graduate education might not be valuable to a much wider range of careers. Part of this is based on a re-evaluation of the value of current graduate education in general for a more diverse set of purposes.

The recent report of the special commission on graduate education prepared for the University of Chicago stated this well: "The fundamental purpose of graduate education is to develop analytical independence and conceptual self-consciousness; to stimulate creative imagination and critical abilities; to inculcate habits of disciplined thinking and systematic investigation; in short, to prepare individuals to ask questions and to formulate problems across a broad range of human activities . . . thus it is our claim for graduate education that it constitutes a true education, not simply an advanced form of professional training."

Stated in this manner, the aims of graduate education do not seem very different from those at the undergraduate

level, although at a higher level of attainment. But while this enunciates the general skills case well, it does not deal with that essential linkage to other subject areas which must also be present in a rounded program for alternative careers. To stop without such linkage would be merely to assert in a self-serving, even arrogant manner, the universality of the particularity one happens to have chosen and which was developed for a prior purpose at that. In itself, this approach will not be convincing. More is required.

For example, at the Claremont Graduate School we have developed something called a dual-degree program in which persons pursue simultaneously an advanced degree, typically although not exclusively a Ph.D. degree in one of the humanities disciplines, and an M.B.A. The faculty, including the humanities faculty, was firm in their notion that the companion degree should be the M.B.A., not a few business courses, a superficial summer session, or some hybrid concoction which would forever have to be explained. The humanities graduate experience has as its component some of the general intellectual skills and orientations mentioned in the Chicago statement, some related additions such as highly developed writing skill, but not only that. It also includes regular disciplinary content, such as a possible developed advanced knowledge in some area of American history, for example. All this is then linked to the M.B.A. degree. While such a combination is very demanding, ways have been developed to pool electives which provide for some efficiency. The point is that the wedding of areas in some way is required. It is not enough merely to assert that current graduate education in the arts and sciences necessarily prepares one for anything and everything. (The Chicago report itself did go on to discuss a few possible combinations).

In areas other than the humanities, such as the social sciences and sciences, the adaptation of graduate preparation to other careers is marginally, but only marginally, less difficult. Perhaps such basically elaborate and cumbersome arrangements such as dual-degrees may not, however, be necessary. The movement of disciplines such as psychology into applied areas is proceeding, but far too slowly.

The second large area of opportunity lies with different student populations. I will come to this later in the discussion of impediments.

So the thesis of this workshop is that society's needs are great, providing incipient or even developed opportunities of magnitude. We need to move to meet them in part to help society, in part to save ourselves.

But an examination of the state of the university in regard to graduate education would be incomplete without realistic consideration of the impediments to such change. They are formidable.

These impediments become evident when we consider what is needed. The quality, effectiveness, and appropriateness of a graduate program involve four things: 1) the ability and preparation of students at entrance; 2) the stature and appropriateness of the faculty; 3) the program design, including the curricular objectives; and 4) the effectiveness in fact of the implementation of the program design. The third of these, program design, is what is at particular issue today. Program design is, incidentally, at once an attractive and much neglected area of preoccupation in graduate education.

Were we to concentrate more on program design and strategy, formidable obstacles would have to be overcome. We have not been out of this business just because we are lazy or never thought of it. There are significant barriers and disincentives. Some of them are in fact long-held and valued explicit strategies, some are largely implicit attitudes, and some are fundamental structural and resource limitations. Some may even be impossible to change in the short run. But it may be instructive to look briefly at a few of them. Some rearrangement, even if only at the margin, is usually possible.

Let's look first at two strategies. They are not wrong, merely partially right. Most strategic assessment and planning, in fact, involves the analysis of trade-offs, partial truths.

The first is the strategy of building strength on strength. Concentration is the by-word. Do a few things well. In a time of retrenchment, this strategy gains renewed support. Who can argue against such a wise strategy, frequently a favorite

of governing boards and state commissions? Certainly most observers agree that we suffer from over-proliferation of programs. But there is a problem with this approach, particularly if one means by strength, faculty strength. It requires a parallel strategy of courageous elimination of programs—a strategy we rarely follow courageously or otherwise. If there is no such combination, we concentrate on doing well or better things which we are already doing. New things, or even major redesign of old things, is precluded in the interest of strengthening the past.

A second strategy, widely held in quality institutions, is that a new or different area should never be entered unless it can be entered in force with high quality evident almost immediately as if William Rainey Harper's hook-up with John D. Rockefeller's resources in the early days of the University of Chicago were modal. A school with which I am familiar examined the formation of a law school—why I do not know. Some very distinguished faculty members proposed very strongly the notion that unless they could compete immediately with the three or four top law schools in the country, they should not try. Of course, they did not try. To do so would have been prohibitively expensive.

But pushed to an extreme, this partial truth is nonsense. Very little would ever be built except in the most favorable of circumstances. Even the top three or four schools were not built that way themselves initially. While it is wise to count the cost before starting on a new or largely redesigned venture, almost all emergent activities and institutions are somewhat shaky at the start and follow the learning curve. We need to accept that prospect.

Moving from the realm of strategies to that of attitudes, a formidable barrier to the inclination to focus on design is a common snobbishness about clients. We have a clear preference built into our systems for full-time, mainline, conventional age students. At the graduate level, we add a preference for students who wish to recapitulate our own careers. We like to teach ourselves thirty years younger. We prefer them to be so bright and well-prepared that we are hardly necessary. A related set of status commitments prefers theo-

retical over applied, vertical specialization over breadth, and established over emergent programs.

Yet many of the opportunities over the next decade lie elsewhere. Minority students, foreign students, part-time students, mid-career students, re-entry students represent the growth areas. Elite, or even merely solid, quality institutions assign these students to institutions down the status ladder which they regard as of lesser quality. This may in some ways be a reasonable division of labor, notably in highly complex, vertical disciplines in which the very young often make the seminal contributions. But the result of this snobbishness and status-preoccupation is that even lower-ranked institutions approach students half-heartedly and grudgingly. All of us should be experimenting to a degree, developing model programs, and keeping our hand in these growth areas—to the benefit of society as well as that of our own institution. In certain areas, as in applied and professionally oriented ones, these students are in fact often superior in certain subject matters.

Another closely related attitude is a tendency to confuse packaging with substance, delivery system with content, familiar structures with goals. These attitudes lead to inferences about quality from such attributes as full or part-time study, time of day of classes, frequency of meeting and conventionality of ostensible educational goals. To be sure, if the program is designed for the usual mode, as in the case of full-time study, then students will appear to be—in fact likely will be—in an inferior position if they cannot fit into these structures comfortably.

But suppose the program were deliberately and carefully designed to meet a different situation? It would be expensive if done correctly, but there are examples of carefully designed systems. We need to share this experience better, in part to contain the questionable programs who have entered these areas in the vacuum we have created.

Some of the most difficult barriers to the redesign of programs come from our university structures. They almost defy modification. Implicit recognition of them undoubtedly inhibits greatly the tendency to focus on program design.

The first is the manner in which we have locked in our faculty staffing with an elaborate and pervasive tenure system. Changes in this system are probably impossible in the short run. But we should note that if we have traded all our program flexibility for tenure, we have paid a very high price indeed. It is important to note also that such a choice is not at all common in other innovative institutions in the society.

The second attribute which poses a barrier to program design is our undifferentiated commitment to participative decision-making. The problem with an uncritical and undifferentiated use of participative decision-making is that it is easy to surrender to vested interests lodged in the past.

But these impediments—strategic, attitudinal and structural—can be modified if not eliminated by strong leadership combined with coalitions of faculty interested in redesign and improvement. The practice of periodic program review, now widely used in graduate education, can be useful as an opening intervention, for example.

All of these impediments, in one way or another, are also bound up with a shortage of money. To examine this vexed issue would take us too far afield. (On second thought, maybe the financial needs of the paucity of genuinely new ventures now evident would not take all that long to discuss!).

But let us just note a few factors. Were we to arrest the decline of enrollment in many disciplines that would, in the independent sector and perhaps even in the public sector, lead to some additional resources. In some areas, enrollments might even burgeon. If outside or private sources of funds are to be found—for example from corporations—new ventures are the likely attractions. Even deeply philanthropic motivations of individuals are stimulated by ventures which meet new and pressing needs.

But, fundamentally, we will need to learn to bootstrap. That is, we will have to adapt current resources to new ends. While demonstrably the university has a poor track record in this area, much of what we have tried has been half-hearted and in a negative context. Forward opportunities are much more motivating than the prospect of negative retrenchment which has as its main carrot the avoidance of total disaster.

Finally, we will need to revive the art of program design, a much neglected area. A good faculty, good research facilities, and a fine university reputation do not in and of themselves a good program make. We are certainly finding out what it means to do without enough excellent students, for example. Program design is what unites these components, just as research design unites a research effort.

We propose, then, today, to hear some illustrations described, to discuss some general opportunities and problems, and perhaps to charge our batteries and steal some ideas.

What are the Major Concepts in Program Innovations in the Various Discipline Areas?

Defining "Innovative Graduate Programs"

James B. Bartoo, Dean
Graduate School
Pennsylvania State University

My task is to set the background for a short presentation by this panel. In particular I am to define what is meant by "innovative graduate programs." Several years ago I attended a session which was trying to define graduate education. I'm not sure how successful that exercise was and I'm not sure how successful we will be today.

For the purpose of this discussion, we characterize innovation as a departure from convention or tradition. We further break down innovative graduate programs into those which innovative with respect to process, e.g., admissions, those that innovate with respect to content—the combined Ph.D. in the humanities with an M.B.A.—those that serve new clients; and those programs which are offered cooperatively with other sectors of our society.

Dean Charles Oxnard of the University of Southern California has stated in his article *Graduate Education and the New Experiential Learning*, and I quote, "There is even a clear danger that changes in our society at the present time are resulting in an inability to invent new disciplines; create new kinds of scholars, form new alliances between old disciplines, try out new and exciting ideas; in short, do all those things that are evidence of healthy, vigorous, creative thinking. For current conditions are forcing old disciplines to draw in their skirts, concentrating on the cores of their being, setting up defenses on the peripheries that touch other subjects (from whence could stem new knowledge). Current conditions still provide a rhetoric of the importance of the scholar with feet in two disciplines, but current conditions are also providing a reality in which a scholar is in double jeopardy at his appointment, tenure and salary increase times, in which such a scholar . . . is perceived by the one discipline as giving hard won or hard kept resources to another discipline, and in which, in the name of financial exigency, "fat" is removed from the system and with it support

for those new areas, ideas, and excitement that are too new to fight for themselves. With efficiency indexes and fiscal accountability can come, if we do not take care, the bankruptcy of intellectual venture capital."

I think all of us can empathize with Dean Oxnard's word picture of the current condition in graduate education. The educational environment is changing rapidly. Programs must adapt. An example is the developing crisis in the teaching of science and mathematics in the schools. As one movement to correct this state of affairs, Dean Oxnard proposes joint operations within the university between graduate schools and schools of continuing education. I would hope we have comments on this process. In this way Dean Oxnard believes universities will better serve the new students with new learning and new teaching with increased emphasis on experiential learning.

Whenever graduate educators discuss innovative graduate programs the issue of quality always comes up, and it already has. As this meeting progresses I am sure we will hear about quality (or the lack thereof) for innovative graduate programs.

Let us examine some of the trends, with respect to innovation and the process of graduate education. Certainly the characteristics of students that we have traditionally served in graduate school are changing. They are getting older. Many of them have professional experience before returning to graduate school. Many of them are part-time students. A few are seeking career changes. Does the admissions part of the graduate process now accommodate these changes? Are the usual measures adequate? G.R.E.'s, junior-senior grade point average, letters of reference? How do we evaluate experience? Do we remain selective at admissions and only pick the cream of the crop or are we going to recognize that all working professionals need some type of professional upgrading that we might call graduate education, and do we then talk about value added by a degree program?

Does the pacing of the degree program fit the needs of these students? Does a normal five-year statute of limitations apply for course work or other requirements? I might note

here there are some very interesting statistics in the new assessment of the research doctorate with respect to the length of time that a student is in graduate school. Many students are running nine, ten, eleven years between the entrance to the graduate school and the award of the research doctorate.

Should there be a residency requirement? What does the residency requirement mean these days?

How can we assure quality? How can we substitute for the traditional quality control mechanisms?

What are suitable substitutes for traditional classroom instruction? Are we going to permit correspondence study, programmed learning material, audio-video cassettes, or closed circuit T.V. as appropriate learning devices or information transmittal devices for graduate education?

These and a host of other questions arise when one ventures to depart from the reductionist, residency, research-oriented, traditional graduate program.

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Innovations in Biological Sciences, Industry and Engineering

Don H. Blount, Graduate Dean and Vice Provost, Research
University of Missouri, Columbia

My area of interest with regard to the Council of Graduate Schools' questionnaire survey includes biological sciences, industry, engineering and areas of their interaction.

In surveying this material one is struck with a variety of impressions. These impressions include the observation that relatively few innovative concepts are being promulgated.

We see minimal innovation, in terms of the process of graduate education e.g., admissions requirements. The changes that became evident in the survey were those related to packaging the content materials. However, the degrees of *innovation* in the packages that we see are not such that they would offer much refutation of Paul Albrecht's comments, as published in the April issue of the C.G.S. Communicator. Dean Albrecht reminds us "that the rate of real, effective innovation in graduate education is shockingly low." Paul goes on to state that we rarely see changes in program design. "The need for improvement in program design is not the same across all types of graduate education," Albrecht cautions us. "Perhaps Ph.D. programs in conventional disciplines are least in need of retooling. But even Ph.D. programs, in new areas, need more work as, for example, in newer interdisciplinary subjects." Perhaps it is the retrenchment mentality of the times or perhaps we are poised on the brink of an era of rapid change. Whatever the explanation, the profile for innovation appears low, indeed.

One of the most recurrent observations that one makes in going through the graduate programs that are described in response to the C.G.S. questionnaire is that it would appear that the greatest changes are occurring in programs due to specific needs perceived in the community. We seem to be *responding to need*, rather than *initiating direction*. This is particularly true in engineering, and is appearing to become true in areas of biology. Engineering is interested in meeting the local needs of industries and attempting to place students

for future employment. Engineering schools are, therefore, interested in establishing programs that rely on a great deal of industrial input, either in their M.A. or Ph.D. programs. A case in point is a program that Marquette University established, in which there is considerable liaison between the university and the local G.E. facilities. Marquette has a three-year six-semester advanced program in engineering in which electrical and mechanical engineering courses are taught with a supervisor and combined faculty of G.E. experts and M.U. faculty. A graduate from this program will get not only a master's degree from Marquette, but also a certificate from General Electric, indicating a degree of proficiency in dealing with day-to-day problems associated with G.E. activities. The program was first suggested by a G.E. program manager and then was initiated by the graduate dean and faculty members from the Marquette College of Engineering.

It is also interesting to note that several universities have installed new programs involving *manufacturing* skills and the *manufacturing* process. This appears to be an outgrowth of industrial engineering activities. While it is not a totally new thrust, it does signal a resurgence of interest in the manufacturing process in engineering programs.

Interestingly enough, the overall impact of the computer revolution is not particularly reflected in the responses by the schools of engineering to the Council of Graduate Schools' questionnaire. One would expect in the coming years that engineering programs will reflect the mammoth impact that computers have had on engineering processes. One would expect particularly to see electrical engineering come to the fore in terms of programs involving computer design and interaction with the computer industry. Also one would look to enhanced relationships with the manufacturing process, in which robotics, quality control and enhanced productivity would be involved.

In reviewing the engineering programs, one is struck by the surprising lack of innovation. It may be that extreme innovation is difficult for engineering programs driven by accreditation requirements. Recruiting demands may also impose restrictions. Industry recruits from the school of

engineering in well-known disciplines, and a new program must take that recruiting pattern into consideration. It will be very interesting to see what impact the new I.B.M. program has on engineering programs. I.B.M. announced in the September 22nd issue of the *Chronicle* that $50 million has been set aside for a grant competition in program evaluation for industrial and other engineering disciplines, computer science, and business administration.

Response to social need is reflected in biological programs, as I indicated before. One of the most unique programs mentioned in a response to the Council's questionnaire was one initiated by the University of Maryland Baltimore County. There, students are trained to a relatively high degree of technical skill (below that creative element required of the advanced researcher, but above the technical capacity of a person graduating with an A.B. degree in biology). The University is offering currently a one-year nondegree program that allows for people in highly sophisticated molecular biological laboratories associated with area industrial companies to teach and share laboratory facilities with students. An internship allows the student entrance into the laboratories on industrial sites and in laboratories at the University. Currently a two-year M.S. program is being sought to create this new elite corp of technically trained individuals. Industry has contributed money for scholarships and contributed faculty and equipment for training these students.

Another impression I might share is that several of the programs appear to be more related now to problem-solving than to single disciplinary-oriented professionalism. One of the best examples is a program that is being carried out at the University of Wisconsin, Madison, in which a Ph.D. in human cancer biology is offered. This approach requires a combination of a relatively large number of disciplines and technical skills. Such training allows for appropriate diagnosis and treatment of the human condition, as well as the development in the proficiency of research techniques into the disease process. The Ph.D. is awarded from a department of human ecology in the medical school at the University of Wisconsin School in Madison. This is truly an interdisci-

plinary topic, in which immunology, biology, anatomy, physiology and others are merged into one curriculum. We will see this more and more as time goes on.

I have chosen only a few of the many programs referenced in the C.G.S. solicitation, in an effort to avoid redundancy, show trends and give examples of programs in the various disciplines. I would certainly welcome comments from those associated with these and related programs in the discussion to follow.

Innovations in Education/Cooperative Education/Continuing Education

Mary Ann Carroll, Dean
School of Graduate Studies
Indiana State University

Dean Bartoo has defined innovation for us as "departure from convention or tradition." Perhaps the single most innovative thing about the three areas I will touch upon—education, cooperative education and continuing education—is the fact that these topics are on the agenda today. Traditionally many, if not most, graduate deans have chosen to ignore these areas as much as possible. In my judgment, the fact that we are breaking that tradition and increasingly concerning ourselves with the programs in schools of education and with what is going on in cooperative and continuing education is an important move, for these units directly affect the health of all graduate education.

In reviewing the information submitted to Dr. Pelczar about new graduate programs in schools of education, I was struck by the fact that none addressed the mounting crisis in science and mathematics in the elementary, intermediate and high schools of this country. I will not take time to cite evidence of that crisis, for you know it as well as I do. Suffice it to say that the federal government, the professional associations and indeed graduate deans know that the public is becoming increasingly ignorant of things mathematical, scientific and technological. If that condition is not altered, our country is in serious trouble. Furthermore I doubt that such ignorance is limited to math, science and technology. I mention this crisis to alert you to the need for innovative graduate programs to address this alarming problem.

The innovations that are occurring in schools of education do not reflect changes in procedures such as admissions standards, residence requirements, etc; for traditionally schools of education have been almost alarmingly nontraditional in such respects. Rather, the new developments reflect the fact that the graduate curricula offered by schools of education are changing.

The three categories of development to which I would like to call your attention are: (1) new programs that are developing in response to pressures of the times; (2) the increasing number of cooperative and interdisciplinary programs that are emerging; and (3) changes in the nature of teacher education programs that may be on the horizon. Let me elaborate on each of these.

Some of the new programs that reflect the pressures of the times are those which have evolved to absorb student losses in teacher education. The phrase "and human services" or something similar has often been added to the name of schools of education to identify the new directions such units are taking. For instance, instead of finding programs in school counseling, we now also find programs in agency counseling, marriage and family therapy, pastoral counseling and the like. These new programs are not without their school of education critics however, for some such as B. O. Smith feel that the business of schools of education is pedagogy and only pedagogy.

Other programs being developed in response to demands of the times reflect the new needs of teachers such as the University of Evansville's master's degree program in computer education and the Queens College master's degree program in teaching English as a second language. One new graduate program that certainly reflects the problem many universities face is the one at Appalachian State in developmental education. This program is designed to prepare persons to work with the academically unprepared student at the post-secondary level.

A number of cooperative arrangements and interdisciplinary programs also have emerged in schools of education. Northwestern's master's degree program in language and cognition involves collaboration among faculty from the Departments of Communication Disorders, Psychology, Education and Linguistics. Similarly, the College of Business Administration and the Teachers College of the University of Nebraska-Lincoln are offering graduate study in health care administration.

Thirdly, there appear to be new forces emerging within

and outside of the teaching profession that are calling for a different kind of teacher preparation. Generally these forces are pushing for a four-year bachelor's degree program in liberal arts with professional education reserved for the graduate level. Thus schools of education might become entirely graduate schools of education and somewhat more like professional schools of law, medicine or business. The proponents of the liberal arts undergraduate program for teachers do not agree on the nature or extent of the graduate professional education needed, but they are in agreement that teachers need more subject area expertise and that such expertise cannot be developed while sharing the undergraduate years with professional education.

Such a movement if realized to its fullest, would radically alter the content of graduate programs in schools of education. A teacher education program that involves professional school experience, extended study time and the development of real expertise in a discipline will require innovation and creativity beyond anything currently proposed or in practice.

Cooperative education, which is designed to provide students with an opportunity to apply their theoretical knowledge in a job setting, is finding an increasingly important place in graduate education.

Traditionally, cooperative education has been largely an undergraduate experience. When it did appear in graduate curricula, it was usually limited to programs in law, business or engineering. That situation is changing.

For a number of reasons cooperative education is becoming a valuable option in many graduate programs. (1) The job market is tight. Many companies hire those they have come to know in a co-op arrangement. Students are aware of this and are attracted to institutions that offer cooperative education; (2) The economy is forcing many employers to reduce their recruitment visits to college campuses. GM reportedly will reduce its visits by 55 percent. Students on co-op programs will be less dependent on campus visitations for job opportunities; (3) The decline in graduate student support makes the paid work experience of cooperative education es-

sential to a number of graduate students who could not otherwise afford to go to graduate school.

Innovation is apparent at institutions such as Northeastern, Drexel and California State University, Hayward, where graduate students are now participating in cooperative education in areas such as anthropology, art administration, biology, economics, English, geography, geology, history, public administration, sociology, speech, statistics and technical and service communications.

To the degree that a cooperative education experience is truly an opportunity to apply theory in the context of reality and supervision, this component can add to graduate programs a dimension of quality not otherwise available.

The most hopeful innovation in continuing education—in my judgement—is the trend toward cooperation between graduate schools and colleges of continuing education. Too long continuing education has been perceived as—and has often been—second rate graduate education. Too long the public has had its only exposure to graduate education through poor quality continuing education. Too long graduate deans and continuing education directors have refused to deal with one another. Now evidence exists that these two units are finally starting to work together. Graduate Dean Oxnard, whom Dean Bartoo quoted earlier, believes that much good can result when graduate schools bring their expertise in "quality" to continuing education, while the latter shares with graduate schools its expertise in organizing cross-disciplinary programs, in reaching out to the community, and in handling a diverse adult student group. On his campus, and with his blessing, the University of Southern California's College of Continuing Education now offers a Master of Liberal Arts, a Master of Professional Writing and a Master of Arts in Applied Linguistics. Such programs that reflect liberal arts, graduate school and continuing education cooperation are indeed innovative by our definition.

For some time, continuing education has used delivery systems unlike those used on campuses. Currently continuing education directors are developing a new delivery system which has great potential for graduate education. This

is called the National University Teleconference Network (NUTN). Its programs are to be carried by satellite, and membership in the network is limited to colleges and universities. The potential of a national university network for helping graduate students and advanced degree holders keep abreast of the latest developments in their fields is quite exciting. The first teleconference is scheduled for January 28, 1983 on the topic of "Productivity in America." I have material here for any of you who are interested in seeing whether or not your institution is a member of NUTN and the name of the contact person if you want to investigate the possibility of membership

Innovations in the Social Sciences

Averett S. Tombes, Dean
Graduate School
George Mason University

We have now been introduced to some views on a variety of innovative programs in education, engineering and the sciences. We turn our attention now to the social sciences, specifically policy science. We begin with a brief historical view. During the past four decades federal, as well as state, regulations have been increasing. These regulations have touched practically every facet of our lives through the mechanism of public policy, directed towards specific sections of society: transportation, education, engineering, health services, environment, as well as various aspects of the free market. During this period political scientists have observed and recorded the formation and implementation of policy and have developed techniques for the determination of the policies' costs and benefits. The Master of Public Administration Degree, which was the appropriate program for the policy analysts, has been expanded subsequently into the terminal professional degree, the D.P.A.

In the last ten years scholars in disciplines other than political science or public administration have begun assessing the impact of the federal and state policies on their areas of interest. This has prompted the beginning of interdisciplinary or interdepartmental graduate programs in political science and public administration departments. Today I am classifying these as innovative, because some linkages, as we have already heard, are new, and are based on the analysis of policy within the social sciences, humanities, engineering, commerce and the natural and physical sciences.

Four examples of such programs include the interdisciplinary Ph.D. in public policy at George Washington University which is beginning this year; the Ph.D. in law, policy and society at Northeastern University, also beginning this year; the new Ph.D. in environmental biology-public policy at George Mason University; and the M.S. in public policy and social research at Rutgers University.

There are also graduate programs too numerous to list, which do not have policy in their titles, but which require several courses in the analysis of policy, as it relates to the disciplines of, for example, economics, education, agriculture and even international trade. In studying the programs listed above there seem to be three conditions that are common in all cases.

First, each of the universities is located in a heavily populated geographical region—Boston, New Jersey and Washington—which supports the considerable state and federal governmental activity.

Second, each of the universities has a number of doctoral programs, which provide a cadre of graduate faculty capable of supporting the teaching and research demands of interdisciplinary programs.

Third, in each case the university has supported the development of graduate programs in both basic and applied areas. Each program contains a clear statement that the graduates should seek employment in government and industry, as well as academia. Since these programs are interdisciplinary and innovative, three notes of caution must be given.

First, if responsibility of the programs' curriculum and faculty involvement does not reside in one department, then the chances of success are considerably reduced. When a program is broadly based there is often no one or no one department available to take responsibility during difficult periods.

Second, since these programs are in metropolitan areas the possibility exists that many of the students will be attending on a part-time basis. In Ph.D. programs where original research is required the success rate of part-time students may be considerably below what is desired.

Third, as we stated in the beginning, the political philosophy of the last four decades had created an environment favoring governmental regulations. In a highly regulated society, policy courses and programs are encouraged. However, the opposite philosophy, favoring deregulation can return as the political pendulum swings in the opposite direction. We are most likely witnessing that change in the country at present. The question then must be raised as to whether the

innovative programs; such as those we have discussed, will survive if the need for these graduates is drastically reduced.

As a final note, you may have read in a recent issue of *The Chronicle of Higher Education* that the University of Pennsylvania has decided to close its school of public policy. This is an indication of the impact that the swinging of the pendulum is having on one of the major universities on the East Coast.

Issues Associated with Program Innovations

Mid-Career Transitions for Faculty: The University of Virginia Institute for Career Opportunities

Clinton W. Kersey, Jr.
University of Virginia

In the University of Virginia's efforts to broaden the role of graduate education, it has developed a program that is sponsored jointly by the Graduate School of Arts and Sciences, the McIntire School of Commerce, and the Office of Career Planning & Placement. This program is entitled the Career Opportunities Institute for Ph.D.s in the Arts & Sciences.

Five years ago, as many despaired over the decrease in the availability of teaching positions at the postsecondary level, many of us at the University of Virginia saw an opportunity to broaden the role of the arts and sciences in society, by challenging the vocational attitude toward graduate education which assumes that all one can do as a result of attaining the Ph.D. is to teach and to conduct research. We pursued this idea, in the belief that Ph.D.s possess many of the skills and personality traits that business and government are looking for in their employees, for example, good oral and written communication skills, highly developed analytical skills, the ability to take a large amount of data and condense it into a useable form, cross-cultural skills, tenacity, and finally, a commitment to life-long learning.

We sought advice from three groups—graduate students, faculty, and representatives of business and government. After meeting with them individually, it became apparent that we would have to deal with four problems of Ph.D.s if our efforts were going to be successful: first, to acquaint them with the world outside of higher education and the challenging careers that it offers; second, to teach flexible thinking and creative ways of using their skills as well as the ability to present those skills to a group of people about whom they knew little or nothing; third, to help them overcome the "crisis of confidence" that most of them exhibited, feeling insecure about themselves and their abilities after having obtained the highest degree that the educational system

bestows. And finally, we had to help individuals in higher education and business overcome the stereotypes that each group has of the other. Many of the Ph.D.s felt that they could not find a position in either business or government that was consistent with their values and interests.

In order to deal with these four problems, and at the same time to convince people that the so called "Ph.D. glut" was a misnomer, a six and a half week summer program was designed to help forty-five Ph.D.s broaden their career options. The primary goal was to help them make well-informed and intelligent career choices.

Now in its fourth year, the Institute consists of three components. The career development component teaches individuals how to examine their career goals, discover promising career fields, and obtain jobs consistent with their values and abilities. The assumption here is that similar functions take place in different work contexts.

The academic component introduces an individual to the tools of management decision making and includes courses in six areas: accounting, finance, marketing, management information systems, organizational development, and business policy. I need to emphasize that we are not a mini M.B.A. program and have no aspirations to be such.

The third component of the program involves informal luncheons where speakers who hold doctoral degrees talk about their successful career transitions. This offers the participants a better understanding of the realities of working in different career fields. Last year, thirty persons from twenty-five organizations and sixteen cities were involved in this phase of the program.

When the Institute was first designed we thought that it would attract persons directly out of graduate school. But in the first year the average age of our participants was 34, the second year, 37, and the third year, 38. Although the ages of the 119 participants have ranged from 26 to 62, it is clear that predominately persons at the assistant professor rank are attracted—persons desiring more geographic mobility, greater job security, and better pay.

In addition, more and more persons at the associate profes-

sor and full professor rank are being attracted. These people have done everything the educational system has asked them to do, and at the age of 40 or older, are asking themselves whether this is the only way to make use of their skills. It is not as though they are considering a second career, because many of them never gave much thought to the first one. They were bright students, and as a result, were encouraged by their teachers to attend graduate school. Before they knew it, they had invested ten to fifteen years in the education system. At this point in their career, they are beginning to wonder whether "making it" in academe is worth the effort. Faced with the prospect of doing essentially the same thing for the next 25 to 30 years, with little or no opportunity for advancement or increase in pay, they are pausing and, as it were, looking up from their books for the first time to see what additional opportunities are available to them.

Whether individuals have recently received their Ph.D. or are tenured, characteristically they come to us in need of two things. First, they come needing to reevaluate the criteria by which they judge success. In many cases they feel that they and their colleagues have defined success much too narrowly; and thus, they are eager to reexamine their definition of a "meaningful career". Second, they come to us needing a supportive environment—one that encourages them to express their hopes, fears, and anxieties. Tragically, most of these people feel that their own college or university does not provide a context where these issues can be legitimately raised or taken seriously without fear of reprisal. It is as though a conspiracy of silence exists on their campus, and so they turn to us out of frustration.

At the University of Virginia we are taking a holistic approach to the problem of graduate education and its expanding role in society. And that is perhaps what is most distinctive about our efforts in this area, because it forces us to take a long-term approach and help people to assess their careers, and not just their *jobs*.

Innovation in Graduate Education: The Issue of Quality

Lewis C. Solmon, Professor of Education, UCLA
Secretary, Higher Education Research Institute, Los Angeles

I was asked to try to relate the issues of innovation and quality. Any discussion of innovation has to be at a discipline level. I am not particularly interested in remarks about engineering programs that are innovative or medical programs that are innovative. I am interested in what have been referred to here several times as programs with "new concerns." I want to talk about these kinds of programs, particularly in the humanities, the social sciences, and education.

The most widely cited measure of quality of graduate programs is derived from peer reviews, based upon criteria such as faculty quality, which means research productivity, and program effectiveness, measured in a variety of ways. There have been a lot of criticisms of these alleged measures of quality. Patrick Dolan argues that large orthodox departments are rewarded for their rigidity and devotion to scholarship, while the teaching function, innovation, and undergraduate education in general are ignored.

That's probably true, but there have been other things ignored, as well. Up to the mid-1970's there was another dimension of graduate programs never discussed in the context of quality: namely, the ability of programs to place their graduates, to find them "appropriate jobs." This function has always been a vital part of education, even when students have claimed to be unconcerned about jobs, or that they are studying because they love the subject or are good at it. They pursue the doctorate, assuming, knowing, hoping they will become professors or researchers or some type of practitioner in their field of study.

Jobs for graduates has always been a goal of graduate education, particularly at the Ph.D. level. I agree with Mr. Kersey that Ph.D. education has always been vocational. Because that goal was reached in about 99 per cent of the cases it was never a "concern," until recently. As the academic job market has deteriorated, many programs have scurried

around, sometimes after considerable planning, sometimes after panic, and sometimes as the result of nonacademically-oriented scheming, to find ways of insuring that those who receive their graduate degrees can find gainful employment.

In a sense, many graduate programs have had to innovate in order to continue to fulfill their vocational function. For example, all of a sudden graduate education and undergraduate education, for that matter, have become concerned with meeting the needs of society and of the community. My sense is that those needs were there before we had a concern for them. I think that when graduate departments claim to be meeting the needs of society this is just another way of their saying they are trying to find their students jobs. There is nothing wrong with this, but let us admit it.

Departments that ten years ago were attempting to acquire highly visible, publishing faculty, are now shifting their concerns towards job prospects and declining quality and quantity of graduate students. What does that say about quality? If quality is only faculty research and publication, then I think it's clear we are getting less improvement of quality than perhaps we did in previous decades; but I think that we have been focusing on too narrow a view of quality. I think what we have to do is look at the goals of graduate programs and ask if they are reasonable and in the interest of students and the public.

In general, the goals of graduate education have been to advance research in a field, to preserve the discipline and to prepare new scholars to carry on. We should observe the methods used to achieve these goals and ask whether they are efficient. Is the faculty committed to achieving these goals? To what extent is the program successful in achieving them?

People have asked how can we really innovate when our goals are to advance research and preserve what is good of the past? I think these are goals which do not conflict with the desire to make sure graduates get jobs, and that faculty do not want to talk about "vocationalism", but the underlying goal has always been a mundane set of process goals, which relate to vocationalism and financial constraints. Today these goals have become more explicit:

- Make certain graduates get jobs
- Recruit new students
- Raise money for support of research and progress
- Identify and educate students in an efficient manner, that is, to survive on less money

We are not talking here about innovation in the sense of telic, popular or idealistic reforms. We are really talking abut a "survival" kind of innovation. I don't think we are even talking about a movement toward new technology, new educational processes, new delivery systems or new pedagogy as ends in themselves. I think current innovations really involve two things: vocationalism and finance. So, what types of innovation are occurring in graduate education? What are the goals of such innovations?

Some disciplines provide students with knowledge and competencies which may be useful in a variety of work settings. An important goal of innovation then might be to help graduates achieve successful careers in new, or at least non-academic, areas.

A subsidiary goal might be to improve the functioning of the area which is newly entered by these people. This could occur if employees at engineering firms could communicate better, if oil companies acted more socially responsible, or if drug manufacturers become more ethical. If students can make these things come to pass in the corporate world, departments may benefit from higher student enrollments, from more secure faculty positions and from more resources from a variety of sources. These improvements might be made by reorienting the curriculum in simple ways such as: adding a writing component to engineering programs or relabelling courses or programs so they appear more marketable.

There are also more complex potential curriculum changes, such as joint programs, and combining business programs with another discipline. However, to ensure that joint program innovations are of high quality, I think we have to ask a number of questions.

First, does the discipline of concern really have something to offer businesses, other than academe? Could, for example, the curriculum of a typical doctoral program in say philosophy train its graduates so they are particularly qualified to

improve the ethics of a corporation? If the answer to the first question is yes in theory, then are faculty willing to orient their approach to achieve such a purpose? Do they have incentives and enough non-academic experience to do so?

Following even a positive response to the questions so far, we must ask, particularly in today's academic environment, whether the same objectives may be achieved in a more cost-effective manner. It's difficult to argue that we are observing a high quality innovation when we observe a student spending from four or five years in a Ph.D. program in English, then spending a summer at one of the "careers in business" programs to obtain a job in a private corporation. There are easier paths for a college graduate to obtain the equivalent private sector job.

Finally, we must ask if all parties to the innovative activity are participating with their eyes fully opened. If an innovation is part of a subterfuge to lure in students for the wrong reasons, or to compensate for the fact that the student cannot achieve his original goals, which were based upon faculty information, then I think those kinds of programs cannot be viewed as high quality educational innovations. But having said that, I think it must be stressed that potentially a wide variety of goals can be satisfied, and in so doing, a program of high quality would be developed. Certainly faculty research and preparation of future academics are valuable goals, but high quality also can exist in graduate programs which seek to achieve other things.

We can train students for work outside academe. We can cater to a clientele of consumers, rather than to a clientele of investors. We can emphasize teaching, rather than research, and thereby seek to prepare students to teach at colleges which stress the former. We can identify specific needs of employers and develop curricula to produce graduates who can satisfy these needs. We can utilize job internships, field studies, etc. We can provide services to communities, things like oral history, consulting, media English. We can employ faculty who have had real world experience. We can try and attract new audiences, although I have some reservations about that. We can even become excellent in a traditional

sense, but in a much narrower way, so the typical history or English department will be very good in a few things, rather than a lot of things. I think that's innovation.

Programs with a variety of these characteristics and goals can be judged of high quality, even if they do not qualify as leading sources of research and publication, as long as the goals are clear, are achieved efficiently and effectively, and are satifying the needs, the real needs, of some clients.

My sense is that many innovative programs try to avoid evaluation. They are afraid they will evaluated in the context of how much their faculty has published. I think that's very dangerous. I think we have to see which programs are doing well, and which programs are poor, superficial, or in some senses even fraudulent. We must use the good programs as role models, because we need more of that, and to identify the poor programs. I think we really have to get to a position, where we can identify goals, evaluate them, see if they are being accomplished and measured well, and define these innovative programs as being of equally high quality to those whose faculty publish, and don't do anything else very well.

Admission Criteria for Mid-Career Students: New Dimensions for the GREs

Bernard V. Khoury, Director
Graduate Record Examinations Program,
Educational Testing Service

In his introductory remarks today, Mike Pelczar pointed to an event which occurred ten years ago, the publication of *Scholarship for Society*. At the annual CGS meetings in Williamsburg, Virginia in 1972, about two weeks after that report was published, there was a great deal of animosity and antagonism directed toward the report. Some felt that it was a prelude to the destruction of quality in graduate education. Few defended it except perhaps for the 15 members of the panel that wrote the report.

We've come a great distance in the past ten years. We no longer hear the same kind of venom expressed about innovation as we did ten years ago.

I'd like in my remarks today to spend a little bit of time on the ostensible topic of my remarks, namely the GRE testing program. Then I'll talk a little bit about quality assessment and devices which exist for appraising the quality of programs, such as those that Lou Solmon described which might have any of several alternative goals or purposes.

The Graduate Record Examinations, with which most of you are really very familiar, have not changed very dramatically in the 30 or 40 years since they were originally conveived by graduate deans—to facilitate the admissions process and to broaden the basis on which admission decisions might be made. The GRE General Test continues to measure very basic verbal skills, quantitative skills, and analytical skills. Programs, innovative or otherwise, still need information about verbal, quantitative, and analytical skills of their students. I haven't heard any disagreement or any remarks which suggest disagreement with those basic premises.

But GREs of course are not the only variables that one considers in the admissions process. In evaluating the admission of students one seeks to look at a variety of background data. Undue focus should not be put on numerical scores such as the GRE scores.

It is even more true, I think, with older students and returning students, that one pay increasing attention to the nontraditional ingredients in their admissions portfolio. Students who have some business or some nonacademic experience ought to be expected to articulate quite well in written and in oral form the purposes for which they might be seeking to return to graduate school. They have a much broader background on which they should be expected to draw in defending their own application for admission to your institution.

If we look at the 300,000 students who take the GRE each year, we see clear changes in the student body that are reflected on your own campuses. For the past decade or longer, the modal age of the GRE test-taker is 22 years. That has been the case for a long time; the highest single age group has been the 22 year-old age group. But, the percentage of people in that age group has been falling over time. In the past five years, for example, the ratio of 22 year-old students who took the GRE dropped from about 22 to 19 percent.

In the past five years the median age of GRE test-takers has increased three years so that the median age of the GRE test-taker is now about 26 years. It was closer to 23 years just half a decade ago.

Half a decade ago 15% of GRE test-takers were older than 30 years; the percentage is now about 30. There have been fairly dramatic changes in the constitution and the demographic make-up of the GRE test-taking population.

The GRE performance of students at different age levels shows that older students tend to receive lower scores on the quantitative measure of the GRE. I think that can easily be attributed to the low active use of quantitative skills. Verbal skills for older students, however, don't show the same kind of decline as do quantitative skills. Again, that is not very surprising because most individuals who consider returning to graduate school continue to be professionally involved in some way and, therefore, continue to exercise verbal skills. It's the exercise of those skills that we see reflected in GRE test performance.

There is another clear distinction that exists between the

older or more experienced GRE test-taker and graduate applicant than the younger one. Many students older as well as younger, are extremely anxious about taking GRE tests. However, it has been my experience that one hears more complaints from older students. I think that although the younger student is fairly anxious, that student will often defer to authority or defer to a requirement in an institutional catalog in a way that an older student will not. So you will encounter the articulate 35 to 45 year-old student who, in being imposed with the GRE test-taking requirement, will not only object to it, but will also object a second, third, and fourth time.

The ultimate measure of the effectiveness of an examination is whether the test is an effective predictor in the admission of students. There are, not surprisingly, very few data that allow us to make clear inferences about the predictive validity of the GRE for older students. In general, large numbers of older students have not been admitted to graduate programs, at least to those programs which have been interested in validating the performance of the test for those particular students.

There's another distinction between older and younger students who take the GRE. That distinction is in the way that students learn about graduate programs. I was pleased to hear Dr. Solmon remark that he regularly asks his own students why they enroll in graduate school. My own experience would suggest that more institutions should do that; they should determine from their own matriculants why those students came to their institution. We've found in some limited studies that students very often make decisions based on *ad hoc* or word of mouth information. Students do not systematically collect data about graduate programs. Graduate deans and schools that are considering assessing where they are right now and where they want to go in respect to graduate programs should ask current matriculants how did you get here? What induced you to come to my school rather than to another school?

Let me now shift in my concluding minutes to some comments about the assessment of quality of graduate programs.

It has been remarked by several speakers this morning that the most visible public efforts to assess quality of programs are really the reputational studies—the Cartter study of the mid 60's, the Roose-Andersen/ACE studies of the late 60's published in the early 70's and the study that is now being published by the National Research Council. For the most part, those studies are remarkably alike. They ask faculty members for opinions about the reputation of other faculty members. These studies get repeated over and over again and draw both a great deal of publicity and a great deal of criticism.

We've also heard today about the increasing interest in acknowledging that institutions have different purposes and, hence, the devices available to assess their purposes ought to be quite different. The Council of Graduate Schools along with the Graduate Record Examinations Board began 10 to 15 years ago to consider how one might appraise the quality of graduate programs which were not in a unidimensional set. How should we appraise programs that are not all unambiguously directed toward the creation of research scholars, that are not all Berkeleys and Harvards, to follow up the example of earlier speakers.

As a result of a long set of research projects and a series of development activities, for the past few years a new assessment technique has been co-sponsored by CGS and the GRE Board; it is called Graduate Program Self-Assessment. Essentially it starts from a premise that institutions have a variety of different purposes. In an audit to appraise whether they have accomplished those purposes, it is important to accumulate a variety of sources of data to inform such a judgment. Further, there should not be a single judgment made about an institution or a program. It is incorrect to rank institutions in a single list from best to worst, once you have acknowledged that those institutions might have different purposes.

The Graduate Program Self-Assessment Service offers devices to graduate schools—both at the doctoral and the master's level—to collect data systematically from their faculty, their students, and their recent alumni, to inform judgments about the effectiveness of the graduate program. There is in-

formation that would allow inferences to be made about research quality, about teaching environment, about producing practitioners, about job satisfaction, about dissertation experiences, and about salary level of alumni.

These instruments are available, not for a national publication, but for self-assessment purposes. They are designed to be used by institutions that are serious about appraising their internal processes and the outcome of graduate education in their own institutions.

We now have doctoral evaluation experiences for a number of programs which have used GPSA over the past two years; the master's level evaluation service, however has been announced only this year. Both instruments are now available for your consideration in the appraisal of the quality of programs which have diverse purposes.

Progress in the Midst of Poverty

James Olson, President
[illegible]

As a former graduate dean and delegate to this body from a [illegible] institution, I am delighted to be here to participate in this experimental one-day meeting and to see many old friends. It is a particular pleasure to be introduced by Dave [illegible]ks. When we were engaged in honest labor, both of us were historians.

I'm going to talk with you for a few minutes this noon about trying to make progress in times of poverty, or at least relative poverty. In recent months the educational press has been full of aborted or only partially successful efforts by public institutions to reshape themselves to meet crisis conditions and to prepare for the future, which may be even more grim than the present. The public institution has many constituencies, and all of these have influence over its destiny. Their concern understandably is with their own particular programs, and in their view the university revolves around those programs. They frequently are able to block the most strenuous institutional efforts at reform.

In virtually every state outside the sun belt, legislative appropriations for higher education have either been flat or have actually declined in the past two years. The principal reason, of course, is the economy [but] I don't think we can assume that when the economy improves, our appropriations will automatically go up correspondingly. In many states the percentage of total state revenues going to higher education has declined, indicating that other priorities are overseeding higher education in the minds of legislators, and I think it is safe to assume of the public generally.

We are just beginning to experience the effect of demographic change, yet many of us, particularly in universities with graduate schools, somehow refuse to believe that the change will affect our institutions. In the preface to an excellent study by David Breneman, "The Coming Enrollment [illegible] Every Trustee Must Know," recently published

by the Association of Governing Boards, Robert Gale, president of the Association, wrote:

> "After looking at statistics on the dropoff in high school graduates for the coming years, I took an informal survey to see how presidents were planning for the decline. Much to my surprise, I found that almost every chief executive queried found his or her institution would maintain enrollments in a stable pattern for the next ten years. A few presidents mentioned that they dare not say anything to the contrary, for fear it would become a self-fulfilling prophecy."

Another factor which will mitigate against increased support for higher education is the attitude toward higher education itself that seems to be becoming pervasive in this country. We've had lots of chatter over the years around the theme, "Is College Worthwhile?" and that is beginning to make an impression. More specifically, we have the attitude that what really is needed is technical training to fit young people to serve as cogs in the wheels of the new technology. We are all aware of the need for what could be described essentially as technicians, but I am concerned when I see bright young people opting for what is essentially technical training as opposed to advanced study in more theoretical subjects.

These conditions affect state legislatures and they affect the federal government. Indeed, I sometimes believe that aside from conditions brought about by demographics, they are nurtured by the federal government or at least by the current administration.

I fail to see the elements of sound social policy in an attitude that moves the federal government so completely from responsibility for the support of higher education—particularly as the world becomes increasingly more complex. After all, it was Herbert Hoover—surely no irresponsible spendthrift—who stated (in his inaugural address in 1929), "the more complex the problems of the nation become, the greater the need for more advanced instruction . . ."

The difficulties which beset our colleges and universities generally appear in exacerbated form in the area of graduate education. Graduate education actually is in a state of crisis.

Let me speak for a moment about two quite different crises whose effect on the quality of graduate education may be similar. I am referring to the crisis in the liberal arts as opposed to the crisis in engineering.

At one pole, we find the distressing situation of doctoral study in the humanities and the social sciences. Here there are falling enrollments because of dramatically reduced employment opportunities for graduates and severely curtailed financial aid for students. Internal morale in those departments is low, as is public esteem for some of what they do.

It is likely that in 15 to 20 years, we will see some improvement in the academic job market because of an upswing in undergraduate enrollments. Thus one of the most painful problems for Ph.D.s in the humanities and social sciences is not likely to be a really long-term problem—but we can't sit back and wait. As Bill Bowen pointed out in his report to the Princeton alumni last year, "maintaining a continuity of excellent scholarship and research in all major fields of knowledge (is) . . . of paramount importance."

Largely as a result of the current academic employment problem, we are seeing a great many of our best students avoid advanced study in the humanities and social sciences, and many such departments feel they are in danger of losing that "critical mass"—the number of students believed necessary to give a program breadth and vitality. The obvious temptation to admit students of lesser caliber in order to protect the "critical mass" is a real danger to quality in such areas of study, as all of you know.

At the opposite pole, engineering, computer science, and some of the other hard sciences are experiencing a personnel shortage of disturbing proportions, especially personnel with advanced, doctoral-level training. Business and industry have such an appetite for technicians that they are offering baccalaureate graduates higher salaries and more up-to-date laboratories than universities can provide to faculty in these fields. The marketplace is thus "eating"—some would say, gobbling—"its seed corn." After the current growing season, there may be nothing left from which to produce next year's crop.

Many departments in the liberal arts welcome enrollment

of foreign students to help them maintain a "critical mass." But in engineering we may have too many foreign students filling slots in programs where enrollments have had to be restricted because of a shortage of qualified faculty and up-to-date facilities, and where, indeed, to complicate matters further, we don't have an adequate supply of American students.

Consequently, we have a situation in graduate education right now where too sparse an employment opportunity at one end of the spectrum and too lucrative an employment opportunity at the opposite end result in the same thing: a serious threat to the quality of the processes and products of graduate education.

Another extremely serious threat to the quality of graduate education is the rising cost to students of their educations. In the last decade, all areas of graduate and professional education have suffered a combination of tripled tuition costs and sharp reductions in student aid. The financial pressure on students has become tremendous. As fellowship programs of all kinds have been phased out, students have turned to borrowing.

Even *with* the availability of guaranteed student loans, many students are accumulating huge debts even before they are out of school. A recent *Chronicle* tells the story of a 23-year-old, second-year dental student at the University of Pennsylvania who has already built a cumulative debt of $47,000, including his undergraduate loans. More than half of last year's dental school graduates had accumulated debts of at least $20,000. The average debt of UM-Columbia fourth-year medical students is $19,000—and we're a fairly low tuition school.

At the University of Missouri, we estimate that if President Reagan succeeds in eliminating GSLs for graduate and professional students, up to 3,000 such UM students will be seriously affected. The proposed alternate plan, auxiliary loans to assist students (also known—with appropriate, if unwitting, irony—as ALAS!), with its fourteen percent interest rate and its requirements that payback begin almost immediately, will simply chase vast numbers of post-baccalaureate stu-

dents right out of school. They will have no choice. Many of the best young minds, who have already fled the liberal arts, may soon avoid advanced education altogether.

Thus far, I'm afraid, I have not alluded to a single problem afflicting graduate education that is not in some significant measure funding-related. From the entering freshman who is unprepared for college work and may never make it to graduate school, to the newly-minted Ph.D. who can't find the teaching position he or she wants, the problems all stem from inadequate resources. One might draw the conclusion from this that the dilemma of quality in graduate education is declining resources. But the problem is more complex than that answer would lead one to believe. Besides, it is unlikely that graduate education will see a vast infusion of new funds anytime in the immediate future. Hence it is up to us to devise approaches to our problems that will provide other solutions. If we in academia do not take action, we will have policies thrust upon us by a variety of conflicting outside forces intent upon pursuing their own welfare, not ours.

Because the problems plaguing graduate education have risen over a period of time from a variety of sources, I believe that those problems must be approached on three levels: an institutional level, which, since it is within reach, is the most immediate approach; a cooperative level, which involves mutual efforts among institutions, particularly within a given region; and finally, the national level, where we badly need an explicit policy on graduate education, something that many other developed countries have had for some time. Leadership for all these approaches must begin here, with you. Who better understands the needs of graduate education than you? Who can be more effective spokespersons on its behalf?

University presidents and chancellors have long told graduate deans that while they don't have much authority, they do have the capability of exercising lots of influence. I still believe that to be true. In one sense, the graduate dean can be the conscience of the administration with respect to academic quality within an institution. But in your role as graduate dean you have other kinds of opportunities to provide

moral and intellectual leadership in your own academic communities. I call on you to exercise that leadership in the months ahead.

The institutional level. Something that all graduate schools of all universities should have is a clear sense of mission. Each program, if it hasn't already, should articulate standards of quality with regard to program outcomes. A beginning, perhaps, is the joint policy statement on the accreditation of graduate education issued in 1978 by the Council on Postsecondary Accreditation and the Council of Graduate Schools.

Indeed, a large-scale program evaluation needs to be undertaken in every institution which has not had one recently. In many universities where resources have become critically short, such evaluations are occurring as a natural response. The University of Missouri is one such institution. Systemwide, on all four campuses, we have undertaken a thorough review of all programs, both graduate and undergraduate. Our four-part review criteria, generally stated, include: current quality of the program; contributions of the program to the campus and the university; need for the program or activity; and financial considerations.

Some sort of organized review process is essential as institutions seek to manage retrenchment. There is much more to it than that, however. I mentioned earlier that public institutions have considerable difficulty in managing decline because of constituent pressures. An organized review system will help.

The cooperative level. But I want to suggest to you that this evaluation procedure is valuable not only to institutions who are having to cut their budgets. For the health of graduate education as a system, institutions need to cooperate in an evaluation of the extent and quality of graduate offerings in a given region.

Institutions within the same region can also, if they will, establish cooperative programs to maximi their diminishing resources. Such moves might include the sharing of facilities, faculty, and equipment purchases.

A particularly fruitful field for cooperation is in the opera-

tion and maintenance of our research libraries. Information has increased to such an extent and costs have skyrocketed to the point where even the best endowed institutions simply cannot keep up with the responsibilities of being completely comprehensive. At the same time, new technology makes possible the sharing of library resources in a way hitherto undreamed of. There is still much to be done organizationally to make it possible for universities to take full advantage of the new technology as a means of augmenting their library resources. University librarians naturally have a leadership role in developing such organizational structures and strategies, but graduate deans could be playing a more significant role than they have to-date.

Another way in which institutions can profitably cooperate is in the area of joint lobbying on all levels. Higher education has never been its own best advocate. Recently, I think we have begun to understand the potential danger of that. One of the most useful things we can do for ourselves is let business, industry, and governments know what we are doing that is valuable to their interests and to society's as a whole. When Frank Press took the presidency of the National Academy of Sciences a year ago, he had this message for those involved in research:

> "The scientific community should organize itself so that the public knows better what it is the scientists are doing, why they're doing it, (so the public) can share in the excitement of scientific discovery and see the connection between a strong American science program and a healthy, well-fed, affluent country."

That advice applies as well to all of higher education, especially graduate education. We need to educate the public continuously about what we are doing and why it is important to them. And if we do this in a cooperative rather than a competitive spirit, we will protect our credibility and serve our own interests more effectively.

We can, in addition, strengthen the lobbying efforts of our national associations by providing them with organized, responsive support. In fact, many of us have made special efforts of that kind in the last few months in order to help

counter some of President Reagan's 1983 budget proposals, and the One Dupont Circle people, it seems to me, are increasing their effectiveness. The headlines that you have been reading in the past few days about congressional response to the fiscal '83 budget reflect the success of all of our efforts, and should increase our confidence.

Cooperative lobbying efforts among public institutions on the state level may also be helpful to graduate education. State governments are generally interested in university research and development activities if we can demonstrate for them how the state will benefit from such research. The Missouri legislature, for example, has just passed a research support bill which explicitly recognizes the relationship between university research and economic development in the state.

The national level. The kinds of problems I have been discussing will be addressed, but certainly not solved, either by individual institutional efforts to shore up program quality or by cooperative effort among institutions to share or try to increase resources. Universities simply cannot solve the problems afflicting graduate education by themselves.

The products of graduate education—research, manpower, scholarship—are national resources. They are of particular importance to business, industry, and government, who need them most. In light of that, I think it is reasonable to suggest that what we need is a *national policy* regarding graduate education. Such a policy might well bring a renewal of purpose and integrity to advanced study and research, and would probably solve most of the problems plaguing us now, particularly if we have also made sincere efforts to put our own houses in order. Many developed countries, as you know, explicitly recognize the function of graduate education in meeting their manpower needs, and so consider it quite reasonable to maintain a national graduate education policy.

Let's consider for a moment the kinds of issues such a policy might help resolve in our own system. It might, first of all, recognize the close relationship between graduate education and research by developing fellowship, assistantship,

and grant programs which take that relationship into account. Generally speaking, except for grants provided by the National Institutes of Health years ago, the relationship between graduate education and research has proceeded in this country on an incidental, unplanned basis.

It might help us deal with the tangled and currently unregulated enrollment of foreign students in American graduate schools by developing a national approach to the numbers of foreign students to be admitted, their level of academic and language preparation, their tuition charges, their countries of origin, their fields of study, and their residency status in this country during and after their graduate study. Such a policy could, for instance, improve the nation's balance of payments by charging foreign governments more than the cost of education. In short, America could become an exporter of advanced education. It is a product in demand, after all, and one which we are well-equipped to provide.

A national policy in graduate education could certainly deal with national manpower concerns by creating salary incentives to keep good faculty in fields where there is a critical shortage or by creating financial aid incentives to attract graduate students to enter fields of the greatest projected employment needs.

And finally, such a policy might even help relieve everyone's distress regarding the employment problem of people who already hold Ph.D.s in the humanities and social sciences by establishing re-training programs or productive ways to utilize their education as *humanists*.

I am not so idealistic that I expect to see such a policy take shape immediately. There is a long tradition of independence in American higher education that has heretofore generally served us all very well. Nor do I believe that such a policy could emerge without strong and intelligent leadership from the academic sector. But these are extraordinary times for higher education, and they call for extraordinarily creative solutions to our problems.

Industry/University Cooperative Graduate Programs

"University/Industry Research Relationships: Myths, Realities, and Potentials," 14th Annual Report of the National Science Board

Carlos E. Kruytbosch, Staff Associate
Office of Planning and Policy Analysis
National Science Foundation

I would like to give you a preview of some results from a major national field study commissioned as background material for the National Science Board report on university-industry research relationships. This report is currently in the final page proof stage. The Board report itself cannot be released until the President has transmitted it to the Congress.

There are essentially two reports coming out of the National Science Foundation on the university-industry topic. One will be the Board report, which will provide some history, a fairly comprehensive data analysis of the trends in the last 20 years, a look at the federal role, and some guesses and speculations about the future of university-industry relationships. The second report, just now entering the printing process, contains six special studies commissioned as background materials for the Board report. This volume will not be forwarded by the President to the Congress and, therefore, does not have to be released by the President.

Because of limited time, I will pick some rather interesting statistics that were generated in the course of the major national field study of university-industrial research relationships. This study looked at a sample of seventy companies and forty universities. Something like four hundred relationships were examined, spanning a wide spectrum of types of relationships and disciplines and industries. The participants on both sides were interviewed concerning how the relationships came about, what their expectations were, what their problems were, what the administrative mechanisms and legal questions and stumbling blocks were, successes and failures, and so on. A good portion of that data was analyzed and will be published in this background report. Some of the most interesting findings bear on key questions about the research relationships.

One of the most interesting questions concerned whether there were prior connections between the academic and industrial participants in the relationships. In about one-third of the 340 cases analyzed for this purpose a prior relationship between the participants had existed. A quarter of them were consulting relationships. It would appear then that consulting relationships frequently result in subsequent research relationships.

Who initiates the relationships? In two-thirds of the cases--and this was quite unexpected--the university was agreed by the participants as being the initiator of the arrangement. Companies took the lead in only about one-fifth of the cases. In the remainder, they were seen as mutually initiated.

Now these patterns of prior conditions and initiation characterized all the types of interaction studied, except for what was called "general research support"--primarily industrial philanthropic gifts of money or research equipment to departments. Companies were slightly more likely than universities to initiate these relationships and prior relationships were much less in evidence in the case of these philanthropic gifts.

What were the motivations offered by the participants as to why they got involved in these activities? The number one motivation for entering into academic research relationships mentioned in over three-quarters of the industrial interviews (and this has been mentioned in one way or another by the previous speakers) is *personnel acquisition* or *recruitment*. Companies are creating opportunities to make early connections with bright new graduate students and faculty scientists from good departments.

As you know, and this has also been mentioned by the other speakers, there is fierce recruitment competition in certain fields and a permanent competition for the best people in all fields. You may have heard of a new computer science Ph.D. who started at $90,000 in California, of course!

New Ph.D.'s with recombinant DNA experience in the plant sciences currently have their pick of 10 job offers each.

So the number one motivation we have historically has

been personnel acquisition. Much more research needs to be done on this, looking at patterns of relationships, hiring relationships between companies and particular departments and the way they change.

The University's number one motivation hardly needs to be mentioned, and that, of course, is the desire for *new sources of research funds* for student support, equipment, supplies, and the like.

The second most important aim of the corporations, in terms of number of times mentioned in the interviews, was *a window on new science and technology*. In about half of the cases this was mentioned as a significant motivation. The traditional one-on-one research grant or contract leverages the industrial laboratory dollar. However, we are seeing an interesting increase in the use of collective arrangements between one university unit and several companies. Examples are the new microelectronic research centers and the somewhat older cooperative research centers often with government participation. Fledgling industry-wide arrangements with many university units, like the Council for Chemical Research and the Semiconductor Research Cooperative are an important new feature of the research landscape. These initiatives have been encouraged by recent federal changes. The 1980 Department of Justice clarification of antitrust, I think, cleared the climate a bit for these types of cooperation. The Department of Commerce is working further on facilitating measures.

Two additional motives mentioned by 40 per cent of the corporate interviews were *general support of technical excellence* and *gain access to university facilities*, including opportunities for education and training, adjunct professorships and personal exchange and so on. Interestingly enough, only about one-tenth of the companies mentioned having become involved in research interaction in order to *solve a problem or get specific information unavailable elsewhere*.

The second and third most frequently mentioned academic motivations, and I think this matter was mentioned by my colleagues here, and mentioned by about a third was that *industry sponsored research provides students exposure to*

real world research problems and provides better training for the increasing number of graduates going into industry.

There were very interesting differences in the corporate and academic perceptions of problem areas in the interaction process. It should be said that academics were a lot more outspoken in their perception of barriers. Corporate managers tended to be a little more circumspect.

In 100 per cent of the interviews at universities, *patents, licensing, proprietary rights and prepublication review* were perceived as problems or barriers in university-industrial interactions. These were followed by 80 per cent mentioning *institutional differences in objectives and goals, administrative structures and time frames*. One-third saw *personal attitudes* as a barrier.

The biggest problems, as seen through corporate eyes, lie in *institutional differences*—in half the cases. This was followed by 40 per cent concerned with *proprietary rights and prepublication review*. Surprisingly, difficulties in arriving at patent and licensing arrangements were mentioned in only one-fifth of the corporate cases, about on par with the one-fifth that mentioned geographical distance as posing a problem.

In the field study report data is presented on the distribution of policies and practices at about 40 campuses regarding patents and prior review as of mid 1981. This is, of course, a rapidly changing scene. Also interesting data is displayed on patent income for a subset of about 20 universities for a couple of years, which suggests that such income, while relatively small, may be increasing.

In conclusion, a strong message is emerging from these materials that university-industrial connections involve webs of relationships of different kinds. They are rarely one-shot in nature. They are also historical and sequential. Certain universities and companies have especially close relations in hiring of graduates, and thus they have alumni in management, members of university trustees, etc. As mentioned above, these patterns deserve much closer study.

One might generalize that the formal relationship flows from the informal contact; that one type of interaction gener-

ates another relationship. The initiatives may alternate back and forth between the company and the university.

Let me give you a little sequence that frequently occurs: A company wants some specific technical or scientific advice, perhaps concerning its own research program, and seeks out a professor as a credible, neutral consultant. While the professor is providing his expertise he sees the company doing some interesting things. In the field study there were some remarkable cases of professors seeing companies doing interesting things and breaking through one type of prejudice. The professor thus sees opportunities for research and negotiates a research relationship. In this phase of the relationship the initiative is seen as coming from the professor. The research proceeds apace and the company tracks the research and maybe utilizes it; but certainly will be watching the bright graduate students, and maybe offering them summer jobs and postdoctoral work on the project. Some of the students may go to work for the company. The web of contacts thus becomes denser and the cycle is repeated in future years.

Finally, a significant new development is the current effort by many large corporations to track these webs of their relationships with universities. They are clearly moving to better understand and to better integrate their philanthropic relationships with universities together with their contract and grant activities.

The View from Academia

Kenneth H. Keller, Vice President for Academic Affairs
University of Minnesota

I thought that in beginning a session of this sort in which there are several of us offering overviews, rather than trying to do justice to the whole topic, I would try to give you at least one view from academia on this question of university-industrial interactions. It is a term I find has become very value laden these days and provocative on our campus, as I suspect it is on campuses of many of the others of you here today. The values that people read into that term, however, seem to go from one extreme to another and from one level to another. At my own institution there is the extreme that expresses great concern that these kinds of interactions between industry and university are disruptive of the purpose of the university; that they are somehow corruptive; that they compromise the independence of the university. At some *sub rosa* level this might well be encompassed in the view that somebody is going to make money from all of this. Such is the view from one extreme.

At the other extreme, many administrators argue that these interactions will increase the value and use of our efforts and the effect of the university. They will provide a stimulus to the institution to improve its own efforts. They will serve a real need. But what well may be underlying that position is the idea that the someone that makes money may be us. Thus there are both the principled and the practical aspects of each view.

I suspect that in this range of attitudes there is some truth in each. In fact, these are interactions which have great danger and, at the same time great promise, and the important thing as we approach them is to recognize that there are changes involved in these new relations. Many of you are familiar with the fact that irrespective of the nature of the change, change is very, very difficult at an academic institution. I think it's Woodrow Wilson who gets credited with having said that changing a university curriculum is like moving a graveyard; the dead have many friends. The diffi-

culties of changing curricula are, indeed, very great and I believe that part of what we encounter in dealing with this new interaction between industry and the university arises simply because it does involve change.

But there are real dangers as well. Universities have always been very protective of their virtue. In the past, they accomplished this protection by minimizing their exposure to temptation. It works, but it isn't always the most effective way if it simply means staying out of sight and/or mixed company. I think we are entering an era in which we are equally cognizant of the need to protect our virtue, but in which we have to figure out how to do that while exposing it. I believe that characterizes, in fact, the challenge of future university-industrial relations, and that our ability to meet the challenge will stem, in large part, from our ability to recognize our own identity and to preserve it, while making use of and exploiting the opportunities to interact with industry.

The question of identity in a collaborative relationship is an important one. Let me give you an example from my own experience in multi-disciplinary research in the biomedical engineering area. One of the things that people working in the multidisciplinary fields discover is that the best work among investigators from different fields who come together on a particular problem arises from the synergy of the effort, the synergy inherent in a situation in which the collaborators bring a different perspective to bear on the same problem. Unfortunately, when they are very successful, as many have been, they try in the next generation to create not the same conditions, but, in fact, the combination of all that they were. That is, they train interdisciplinary scientists to take the place of the multidisciplinary group that they themselves had been.

More often than not, the result is a disaster. The consequence of blurring the lines among disciplines and removing the distinction is to eliminate the synergy, to eliminate the great value that comes from approaching a problem from different points of view.

From that perspective, I believe that what we ought to be looking for in university-industrial interactions, whether in

training or in research, are ways in which each partner preserves its own identity, but joins forces in a common effort.

I think one of the best examples I know of in our own university of how interdisciplinary collaborations have worked is in my own department, chemical engineering, where we have two investigators, Skip Scriven and Ted Davis, each very well known in his own basic discipline. Scriven is a fluid mechanics expert and has earned a reputation for over 25 years in fundamental studies in fluid flow, particularly in recent years in flow through porous media, very esoteric material. Ted Davis is a theoretical chemist, and in recent years has become very interested in interfacial thermodynamics, a new and highly sophisticated field. These two came together about ten years ago and discovered that the problems in which they were interested were the problems that underlie the whole field of secondary and tertiary oil recovery. Thus, they have put together a multidisciplinary effort involving graduate student training, research, and outreach; one that brings together the practical interests of the oil companies and the fundamental interests of university research; one which allows them to train students in very fundamental work while serving the needs of industry. Indeed, their work is very well supported by industry, because its applicability is obvious. It is an example of the way in which the distinction in purpose is maintained by the institutions but they can come together in a common kind of goal. I think if we are to succeed in programs involving university and industry that this kind of development effort is necessary.

These same considerations apply when one addresses curriculum development and cooperative programs between universities and industry. There has been in our university—and I am sure in others—an emphasis on the part of industry in encouraging its own employees to increase their level of education, to take courses which are applicable to their professional assignments and certainly increase their competence—in short, the kind of program that fits the definition of continuing education.

However, people must be motivated to spend their evenings and weekends in this extra study and it is natural for

them to expect a reward for their efforts—a graduate degree. Thus many industries will argue that when a person has taken a sufficient number of credits, he or she should be awarded a master's degree.

Now I believe that, in many cases, this represents a bad approach, a bad approach because it ignores the characteristics, the identity that should be associated with a graduate degree. A graduate degree program should not be simply a collection of courses, but a structured set of courses, providing information in depth and focused rather than random, a purposeful group of courses aimed not necessarily at rewarding additional work, but creating additional challenge, providing additional perspective as well as additional information. Therefore, as universities attempt to accommodate the needs of industry, they must be careful to preserve the characteristics of the graduate degree program if they are to serve those needs appropriately.

On the other hand, there is room for flexibility. I see the use of residency requirements, full-time residence requirements, as one of the great problem areas in providing graduate degree programs for industrial constituents. While I understand what underlies a residency requirement—the need for intercourse with other graduate students for thoughtful interaction with a broad range of programs—I am not always sure that is only accomplishable through residency-based programs or by a residency requirement. I think there is room for the university to identify the reasonable purposes of a residency requirement but to find other ways of accomplishing those purposes. For example, I think there are ways of restructuring courses and restructuring graduate experience in different time slots, scheduling regular courses in the evening so that day students can meet with evening students during an evening class. Indeed, the gain is a mutual one. In making these adjustments, it is important to keep in mind the appropriate ends of the graduate experience and to experiment with other methods of achieving those ends.

There is, of course, on the other side of graduate education the question of research. I won't go too deeply into that, except to say that this university—as others—is now involved

in a number of interactions with industry that cover a broad range of programs, from industrial associates programs to our Microelectronics and Information Systems Center, a significant multidisciplinary research and training center funded by a number of industries for the purpose of carrying out research that is initiated in the university, but satisfies the obvious interest of our local computer companies. We have also entered into agreements in which we use an industrial firm as a broker to find funding for investigator initiated proposals in the area of biotechnology. In this arrangement we get full funding for our research—and yield patent rights in return for stock equity. There are other arrangements as well and we are struggling with establishing guidelines to govern how those are carried out in ways that are appropriate for the university.

In establishing those guidelines, we have identified the areas which we believe to be of greatest concern and have set some ground rules including the following: all research that goes into the university must be open; all research must be initiated within rather than outside of the university; no single company can control so much of our resources that it could skew the direction or balance of research in a department; there must be a mechanism for outside peer checks to see that the skewing does not, in fact, occur in the units in our university that are involved in such collaboration. We are also putting limits on the financial involvement of individuals and the university with particular companies. In this way, we hope to bring about those kinds of collaborative efforts that meet both the legitimate needs of industry and the legitimate needs of the university.

The View from Industry

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I have a few minutes to discuss the view from industry—much like the preacher who attempts to tell the history of creation in a 20 minute sermon. I can talk only about one view; from one person, in one industry, and let me preface it by recalling my experience when I was completing my degree at the University of Minnesota.

I was quite open about the fact that I wanted to work in industry. A professor very solemnly pulled me aside one day and said, "I can't understand why you want to get a Ph.D.—if you're not going to use it." That type of thinking we must address in this session. Being "on the fence" between academics and industry is an enjoyable experience—the reality is that you are suspect in both camps. To discuss the view of academics from industry we must consider two key concerns, or perhaps "obsessions" that affect the relationship between industry and academics.

First, I don't think anyone here can seriously doubt that we are in a time of crisis. We heard former Vice President Mondale address the productivity and economic issues we face as a nation. American industry's concern with productivity has become a long overdue obsession, reflected in the short term by the attention we pay to the Japanese, and in the long term by our looking to graduate schools and higher institutions to help us find a way out of our productivity dilemma. We are looking for ways, as an industry, and as a nation to compete, maintain market share and retain our standard of living.

The concern for productivity, however, is rooted in our need for new forms of leadership. We know we must explore new models for leaders and new methods of management. Frankly, we are looking to academics—former and future students to provide us with new ideas, theories, and directions for managing a changed workforce in a more productive fashion. We recognize that the time has never been better

for industry to work cooperatively with higher educat on to try to resolve the dilemma of productivity.

A second concern, in addition to productivity, is the need for even greater advances in technology. We have just heard from Vice President Mondale that our future relies heavily on increased technology. From industry's viewpoint, advancing our technology will require the type of cooperative relationship we have been able to establish here in Minnesota between Honeywell and the University. I will tell you about that effort later.

The National Science Foundation recently completed a study which reported that technology that is used for greater productivity will provide twice the productivity increase, triple the growth rate and one-sixth as many price increases. We must continue to apply technology to our productivity problems in general, and academics must help us.

How do these two concerns affect the relationship between industry and academics? Let's look at technology first. I don't want to go through all of the dreary statistics, but the shortage of trained scientists and engineers which we are facing today is a national problem, and one that is rapidly getting worse. In high technology companies, such as my own, naturally we are concerned because our future is at stake.

As you know, engineering doctorates have fallen off 29 per cent in the last seven years. The starting salary for a Ph.D. in industry is $46,000, as opposed to the starting assistant professor's salary which is somewhere between $23,000 and $26,000.

Industry is concerned with the question of who is going to teach the scientists of the future? To be sure, we in industry must take some responsibility by having hired away a lot of key talent for our own purposes. That's a problem industry must begin to confront, by becoming part of the solution, rather than continuing the problem. We must also find ways to encourage students, particularly women and minority students, to pursue technical degrees, and teaching careers in technical fields.

In the last few years, initiatives have been made, not only by Honeywell but by other companies to try to pull students,

especially talented but disadvantaged students, into engineering or technical fields. Scholarships, internships, grants, paid leaves are available to encourage current students to become future employees and current employees to become students again. Industry, working jointly with universities, must try to insure a supply of talent for the future.

It has often been said that industry is preoccupied with the short-term. There are signs at Honeywell, however, that short-term concern is giving way to investments in long-term development programs. We are working with the University of Minnesota to sponsor an on-site Engineering Master's program. Faculty from the University teach employees after hours. We also use university faculty to update technical employees in special development programs. The University has been extremely responsive in working with us to develop these new programs, and together we are exploring new ways to increase the technical skills of our employees.

As an additional concern, several national studies indicate that office automation and other technical advances will produce an increased need for training and retraining, due to displacement and the need to acquire new skills. We will not be able to complete all of the training which will be necessary. Here is an opportunity, I think, for higher institutions of learning, working with industry, to devise ways in which career redirection can be pursued by employees displaced by technological advances.

Finally, in the area of technology, we have seen a number of innovative relationships between industry and academics develop in the last few years. These relationships have reduced some of the traditional obstacles that have prevented research between higher institutions and industry. One such obstacle has been the concern with publication. Industry has—in my view—been overly concerned with proprietary rights in the area of certain research, but recently we have been a number of breakthroughs that have innovatively addressed the publication concerns of both parties.

Another concern in the past has been patent agreements. Recently there have been a number of creative agreements between institutions and industry, particularly at Harvard

and Yale resulting in joint patents and new ventures which hold promise for future joint activities.

I want to talk briefly about industry's concern with the interaction between productivity and leadership. We have been investing considerable resources at Honeywell in visiting facilities of engineering schools around the country. We are concerned that engineering schools and technical schools are not producing engineers who are trained for management positions in the future. Too many engineering-technical graduates enter industry able to perform technically, but unable to assume positions of leadership. Given today's workforce, it is necessary to create a climate where people are valued, achieve meaningful goals, and experience self-esteem. This requires managers with more than technical competence, managers who are effective with people.

Studies done by advanced technology industries such as Honeywell, have determined which leadership characteristics successfully create a positive, productive employee work environment. These studies, done in close association with university faculty, have formed the basis of our development efforts.

We need engineers and scientists who are effective because they understand group process, interpersonal dynamics, and psychology. Technology advances so rapidly that while the "half life" of an engineer in technical ability may be very short, his or her ability to lead other engineers is unlimited. Leadership ability is grounded in an understanding of human behavior that we think technically trained people must obtain earlier in their careers. We look to academics for help in developing this understanding.

As an example, we are currently investing over half a million dollars each year in a program to develop the "people skills" of engineers. Working with the University of Minnesota, we teach our engineers new methods of management. We are also interested in programs like the Wharton School Internship to Careers and the New York University's Career Switching in Ph.D.s. Those are examples where cooperation of industry and academics provides solutions to pressing human resource problems. (As an aside, the climate for hiring

Ph.D.s in industry has never been better. We are seeing a major change in attitude toward the hiring of Ph.D.s in our academic environments.)

In conclusion, what is needed to encourage the successful cooperation that is happening today? We must continue to address attitudinal barriers; the time has never been better. Industry's obsession with productivity and academia's concern with funding and cutbacks have produced a climate of mutual self-interest in the service of joint goals. At Honeywell, for example I see a greater willingness on the part of managers and executives to invest for the long term in academic research, not only in terms of equipment and scholarship, but also in outright grants to institutions to address productivity and technology problems. Our long term success depends on the success of these joint ventures.

In terms of changing attitudes, I think the kind of collaboration that results through such joint programs will mean that managers will be retrained in academic fields; there will be greater hiring of Ph.D.s; and increased use of academic faculty to teach industry programs that, in the long term, are beneficial in addressing the needs industry is facing.

Finally, I think industry must "back off"—as we say—from evaluating relationships with academics, strictly in terms of return on investment. In many quarters of industry the thinking maintains that if we fund institutional programs, we should have some direct return. We now see a change in that thinking, and I hope that closer cooperation will eliminate such an attitude.

The Industrial Affiliate Program

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The perspective I can provide on issues of industry university cooperative programs from an academic viewpoint is a multi-faceted one—first, as a faculty member who focuses research efforts on materials and specifically on polymers and their composites; second, as director of the industrial affiliate program in Chemical Engineering that facilitates one on one interactions of faculty and students with their industrial counterparts; and third, as founder of the Polymeric Composites Laboratory, a recently established entity that is geared specifically to basic research undertakings in polymers and composites with strong industrial participation and support.

The National Science Foundation, which sponsors our research project that focuses on crystalline polymers, is a good example of how a funding agency operates under the peer review system. After submission, a proposal is then sent out for review by peer scientists. If it is judged scientifically worthwhile within the budgetary constraints, it is funded by the program from its allocated annual budget. In order to encourage closer industry university relations, the National Science Foundation created the Industry University Cooperative Program (IUCP) that provides additional funds to already existing programs like the Polymer Program to fund successfully peer-reviewed research projects that are undertaken in collaboration with industry.

My experience with the Polymers and IUCP programs has been quite positive having now gone through a project renewal as well as a change in the collaborating industry from Hercules, Inc. to the DuPont Co. of Wilmington, Del. The research scientist from Hercules provided support both in terms of materials and in the problem definition. He was also instrumental in getting management commitment to the project as well as carefully defining the extent of participation of his organization. Commitment was made in terms of well-

characterized samples, equipment, personnel time, and supplies. To further facilitate our interaction, the research scientist from Hercules was also appointed as affiliate professor in the Department of Chemical Engineering at the University of Washington. This appointment provided recognition to our cooperation from both the industrial and the academic point of view for the benefit of both. Our project was funded for a two-year period and was successful. However, the departure of the senior research scientist to join academia on a permanent basis as well as our shifting of interests to crystalline polymers other than polypropylene, provided the motivation to begin collaborations with other scientists.

As a result, a renewal proposal for the research project in collaboration with the DuPont company was submitted to NSF and approved for a 3-year period. The senior research scientist from DuPont was appointed as affiliate professor in the Department of Chemical Engineering. I would like to mention some of the benefits that can be derived both in teaching and research from the University's point of view. Dr. Vassilatos, my counterpart at DuPont, has lectured in courses during his University visits as well as supervised and assisted students in their theses. One of my Ph.D. students working on this project has spent time at DuPont working under Dr. Vassilatos' direction. As a result of discussions, coordination, and interaction, cross fertilization of ideas in this type of project is now the norm rather than the exception.

My experience with this project over the past five years has been very positive. First, it provides an incentive for doing research with industry in an academic environment after going through the peer review process. Thus, by having the project sponsored through the National Science Foundation, the cliché that industrially sponsored research is "more applied" than fundamental is definitely eliminated. For young faculty members who will be judged for promotion and eventual tenure, this is significant. It strongly establishes their academic credentials while at the same time allowing them to interact with industry in a constructive and useful manner for their research growth. I think my counterparts in industry