

4. GRADUATE/PROFESSIONAL EDUCATION AND RESEARCH

INTRODUCTION

This report is one of seven reports generated for the Middle States Review of Rutgers–The State University of New Jersey. Rutgers is a large and complex university with a multidimensional mission, serving the state with many undergraduate and graduate/professional programs on three campuses in New Brunswick, Newark and Camden. Three of the reports prepared for the Middle States review focus on specific campus plans, two focus largely on infrastructure issues, and two focus on education and research across all three campuses, attempting to provide a university-wide perspective on our programs, their current status and their specific goals. This report focuses on our graduate and professional educational and research programs.

Our charge is particularly complex and diverse, because of our multidimensional graduate and professional programs. In order to provide the breadth of analysis necessary, we created a committee composed of senior faculty members from programs in the arts and sciences, from the professional schools, including law and business, and from among the members and leadership of the university’s centers, bureaus, and institutes (CBIs). Thus the committee has the appropriate expertise and seniority to deal with this complex charge.

Most of our academic departments and professional schools and the graduate and professional training programs that arise from them are organized and function in a manner typical of AAU institutions. Over its history, Rutgers has made extensive use of alternative academic unit organizations, and so in addition to a full and diverse range of traditional departments the university has approximately 90 recognized CBIs. All of these arose as a way to further the specific goals of the university in a particular area of focused interest or opportunity, especially those involving research and graduate education. Our traditionally organized departments and training programs interact in a variety of ways with the faculty and research resources of the CBIs and are thereby enriched. The complexity of these interactions is really best understood on a case-by-case basis since the nature of each CBI generally quite unique to its particular mission.

Rutgers has made the critical decision to seek university-wide, rather than campus by campus accreditation by the Middle States Association. This clearly reflects the concept that Rutgers is one university. As President Lawrence stated in a memo to the Board of Governors in May 1996, “Rutgers is The State University of New Jersey; its 29 degree granting units are based in three main locations, not on one main campus and two smaller branch campuses.” The graduate and professional educational and research activities of the university are closely bound to each other, and faculty at all campuses share fully in the benefits and responsibilities conferred by the status of Rutgers as a comprehensive senior institution and member of the AAU.

The major universities of this nation are the “keepers of the flame,” the keepers and generators of specialized, advanced knowledge that has the power to advance humankind and to solve the complex problems of our nation and of other nations. The major universities have the appropriate resources in faculty and programs to educate people at the graduate level, and to carry out advanced research in all

areas of scholarship. Often these institutions have the resources to locate campuses across the states they serve, forming a uniquely strong educational network that can best serve the educational needs of the diverse population of the state. The quality of this educational and research process cannot be achieved by smaller, standalone educational organizations which lack the depth, resources, and experience to carry out advanced graduate work and research.

A natural extension of the role of faculty and administrators in major universities is the responsibility to make highly complex judgments about the nature and the quality of programs and schools at the core of this advanced knowledge, and to make recommendations concerning the training of the future generations which will use and advance it. At Rutgers the diversity of our programs and research areas makes this task a considerable one. Yet the depth of the professional experience of our senior faculty also makes such a review process possible and productive.

For this report we have divided our reply to the charge into three parts, emphasizing those aspects of the charge from the Middle States Committee that are programmatically specific enough to require recommendations appropriate for the multidimensional goals of the university. From its inception, the committee felt that the goals and recommendations which would come from our report could not be unitary across all academic and professional fields represented at the university. We have deliberately resisted oversimplifying and homogenizing the review of our academic units and the examination of their goals, since only specialized recommendations will have real utility in focusing our future work. Thus our report is lengthy and complex, and our recommendations many and far reaching. This is the only appropriate outcome of such a report for a university with the multidimensional training and research missions and the resources of a large, comprehensive public institution.

Each of the sections of this report was generated by a subcommittee headed by a senior faculty member with specialized knowledge and much experience in the specific matters to be dealt with in the charge. Some sections of the charge require responses from each of the subareas we have examined, while other issues are addressed in only one of the subcommittee reports.

The first section of the report—Arts and Sciences—was generated by a subcommittee largely drawn from members of graduate programs in arts and sciences across all three campuses of the university. It focuses on the rich and highly diverse training and research programs at Rutgers that are of a generally traditional nature. Many of these programs have an umbrella structure and draw from faculty who are focused in particular academic specialties but are associated with a range of traditional departments. The connection of basic research in the arts and sciences with advanced graduate education is an area of critical strength at Rutgers. Graduate training programs, from the most abstract point of view, seek to educate flexible, intellectually responsive individuals whose education will continue to serve them and their society long after the narrower aspects of particular training in a subspecialty become obsolete.

Much of the strength of our basic research is found in traditional departments, but an additional repository of our research strength, and therefore our graduate training strength, is in the activities of our CBIs. While many universities organize their faculty and research strengths into these types of units, few have the number and diversity that Rutgers does. The second section of our report—Centers, Bureaus, and Institutes—focuses on the structure and productivity of the CBIs, as well as their relationship with academic departments and their connection with graduate training programs.

The third section of this report—The Professional Schools—addresses research and training issues in the professional fields. Rutgers offers professional programs in law, business, education, engineering,

nursing, pharmacy, and social work, as well as a number of professional programs in the arts and sciences and in education. To a certain extent, the definition of professional training programs clearly differentiates them from certain of the graduate training programs in the arts and sciences, and so the first and third sections of this report may have some overlap. Our professional programs undergo both the external peer review process that Rutgers has devised for its arts and sciences programs, and also the specialized accreditation reviews organized by the various professional accrediting bodies charged with assessment of national professional standards. Many of the professional training programs have very well-defined goals for training for future practitioners. This consideration profoundly affects the nature and requirements of our professional programs.

The final section of this report—Recommendations—groups together the recommendations from each of the three subcommittees. These goals are far reaching and complex, as befits a major university with the faculty and resources located on the three campuses of Rutgers. The ability of such a university to respond in the future to its mission of education, professional training, and research across the diversity of academic and professional areas to which it aspires is largely determined by its ability to plan well, even in the face of the complexity of our political, economic, and cultural environment and our own internal complexities. With planning that meets the challenge of the complexity of the university, Rutgers can expect to enhance its high level of scholarly achievement and potential, and can ensure that the whole university is a great deal more than the sum of its many parts.

ARTS AND SCIENCES

INTRODUCTION

This report of the Arts and Sciences Subcommittee to the Graduate/Professional Education and Research Self-Study Committee for the Middle States Association Accreditation review provides a critical evaluation of the current state of graduate education and research at Rutgers from the perspective of the arts and sciences. The report has been prepared with two goals in mind: to provide material specifically targeted towards Rutgers' planning efforts as it prepares for the Middle States Association ten-year accreditation review in spring 1998, and to respond to the charge from President Lawrence to provide a framework for national recommendations on institutional policies that will improve graduate education. As chair of the AAU Graduate Education Task Force on Institutional Policies, President Lawrence has called upon the committee of the whole to recommend the best standards and principles for institutional policy reforms. We have therefore made a particular effort to address issues growing out of our analysis of graduate education in the arts and sciences in the context of national conditions in higher education today and, specifically, in the context of the institutional policies and responsibilities appropriate to a major research university.

The arts and sciences provide the cornerstone for both undergraduate and graduate education at Rutgers, and are a major source of the university's energies and reputation in instruction and research. Together on the three campuses at Camden, Newark, and New Brunswick, the arts and sciences departments carry out approximately 75% of the total instruction and are responsible for about 75% of the Ph.D. degrees awarded annually.

The quality of Rutgers' graduate programs has been improving in a number of measurable ways. Our arts and sciences graduate programs have been recognized as among the best in the nation by recent surveys, especially the National Research Council's *Research-Doctorate Programs in the United States*.¹ Eight of the Ph.D. programs on the New Brunswick campus are now among the top 20 nationally, and rank considerably higher than that if only public universities are taken into account. Mathematics and physics are ranked in the top 10 of public research universities. Based on an analysis of the National Research Council's rankings,² Rutgers ranks 35th in the quality of its graduate programs among all Research I universities nationally, and 15th nationally among all public research universities. Several programs in the humanities and social sciences are in the top 20 nationally according to the National Research Council rankings: history, philosophy, English, and geography in the humanities and social sciences, and physics, computer science, and mathematics in the physical sciences. Others, such as psychology, and molecular biology and biochemistry, ranked well in a large field of competitors, or registered considerable improvement over the last survey 10 years earlier (art history, comparative literature). A less systematic report in *U.S. News and World Report* reflects these standings also, and includes the rating of Rutgers' Women's History Program as first in the nation.

On the Newark campus there are 10 interdisciplinary doctoral programs, six in the sciences and mathematics, and four in the professional fields of criminal justice, public administration, management, and nursing. The doctoral program in behavioral and neural sciences is gaining national and international recognition and is one of the most successful units in the university in obtaining federal funding. Newark also offers strong doctoral programs in applied physics and mathematical sciences (both jointly with NJIT), and in biology, chemistry, and psychology. Strategic planning of doctoral program growth in tightly focused areas has permitted the campus to attract and retain outstanding faculty and to increase its external funding significantly over the past decade. With five relatively new doctoral programs now in place, the output of Ph.D.'s is expected to increase, and the campus is positioned to attain a Carnegie classification as Research University II in the next few years. Nineteen master's programs in professional fields and in the arts and sciences are also offered.

Nine master's level programs are now offered on the Camden campus: biology, chemistry, English, history, liberal studies, nursing, public policy and administration, business administration, and physical therapy (jointly with the University of Medicine and Dentistry of New Jersey [UMDNJ]). Students may also participate in a range of joint degree programs with other Rutgers academic units, for example, law and political science (with the Eagleton Institute of Politics), urban planning (with the E.J. Bloustein School), business administration (with the School of Management), and social work (with the School of Social Work).

Despite the enormous strides our university has made in graduate education and research during the past decade into the front ranks of institutions nationally, there is cause for concern. Rutgers has not been

¹ Goldberger, M.L, Maher, B.A. and Flattau, P.E., eds. *Research-Doctorate Programs in the United States: Continuity and Change*, sponsored by The Conference Board of Associated Research Councils. Washington, D.C.: National Academy Press, 1995.

² Webster, David S. and Skinner, Tad. "Rating Ph.D. Programs: What the NRC Report Says ... And Doesn't Say," *Change*, May/June, 1996.

spared from the questions raised in the media and in national public debates about the relevance of higher education and the efficiency with which it operates. The response of academia as a whole, and of the Rutgers community, has been to take the criticism seriously, to examine closely the nature of our central mission and how well we are fulfilling the responsibilities with which we are charged. Difficult and complex issues in the areas of enrollment, the graduate curriculum, advance to candidacy and the dissertation, and postgraduate prospects are addressed in this report. We have attempted to place the strengths and weaknesses that we perceive in graduate education and the research enterprise at Rutgers in a national context and to make recommendations that make sense for Rutgers and will help to maintain and expand the areas of excellence at Rutgers which provide the intellectual foundation for a world class university.

The graduate programs at Rutgers–New Brunswick, Camden, and Newark together encompass more than 80 academic departments, not including the professional schools of education, law, and social work. Graduate education varies greatly in its ethos, programmatic requirements, and funding patterns among these different units. However, to facilitate the analysis of policy issues affecting graduate education, we have grouped the disciplines into major fields that constitute the arts and sciences and share many common experiences and modalities. Using the categories developed by the National Research Council we have focused our attention on five groupings: arts and humanities, biological sciences, physical sciences and mathematics, social and behavioral sciences, and engineering.

We begin the report by providing an overview of the national context in which the debate concerning the future directions of graduate education is taking place. We then describe institutional planning and self-assessment strategies that are useful in determining future directions. Next, we assess current trends in graduate education, and their implications for decisions on national policy issues. Then we discuss problems facing graduate students, and we assess the impact of financial issues on graduate education. Finally, we examine the relationship between the university’s research mission and graduate education, and we discuss of the impact of graduate education on society. Tables which summarize current trends in graduate education and research, nationally and at Rutgers, are included in an appendix. Specific recommendations are made within the text of this report, and summarized in an accompanying document.

GRADUATE EDUCATION: THE NATIONAL EXPERIENCE

The structure of graduate education at the doctoral level in the United States, culminating in an intensive research experience and dissertation, has served as a world model for the advanced training of a nation’s scientific and cultural leaders for many decades. Our great research universities provide a uniquely fertile environment for original inquiry and discovery leading to technological, economic, and cultural development that is unmatched by any other institution in our society. Our nation’s graduate schools are the training ground for the leaders of tomorrow and the source of the intellectual vigor needed to address the challenges that we face as a nation.

Graduate programs in any major university are arrayed along a continuum in which both creation of knowledge (the presumptive domain of arts and sciences) and preparation for its application (the presumptive domain of the professional schools) are to be found, albeit in different balances at different points along the continuum. It is a rare graduate program that is purely theoretical, and a rare professional program that is purely vocational. Thus, a rigorous doctoral program in one of the experimental sciences will inevitably send some of its graduates into industrial laboratories where the expectation is that discoveries must “pay” for themselves, and some lawyers and business managers, through the creative

pursuit of their clients' interests, will in effect "discover" new theories of human organization and behavior. And, of course, university professors must continually bridge the gap between theoretical and applied knowledge for their students as well as for their research.

Graduate education in the United States is undergoing a period of intense public scrutiny and self examination. Reports have claimed that we are enrolling too many students in our graduate schools, that the oversight of their training needs to be improved, and that the graduate curriculum and the research experience need to be more closely tuned to the needs of employers who hire new graduates. How should these criticisms be addressed? When trying to determine what needs to be done now, it is useful to consider some recent history concerning the supply and demand of Ph.D.'s and to compare that with current predictions.

In the years immediately following World War II through the early 1970s, higher education in the U.S. experienced a period of unprecedented growth. Fueled by the technological competition with the Soviet Union and an expanding economy, the government used newly created federal agencies, including the National Science Foundation, the National Institutes of Health, and the Department of Defense to provide the financial underpinnings for this expansion. By 1973, the annual production of Ph.D.'s in the U.S. reached an all-time high of 34,000; for the first time since World War II, there were too few academic jobs for the Ph.D.'s being produced. An influential rationale for continuing large graduate programs in the social sciences and humanities appeared in 1989, however, when Bowen and Sosa published *Prospects for Faculty in the Arts & Sciences*,³ and projected substantial excess demand for new faculty over supply beginning in the mid-1990s through the first decade of the next century. In a follow-up study published in 1992, *In Pursuit of the Ph.D.*, Bowen and Rudenstine reaffirmed the earlier predictions of a shortage of Ph.D.'s.⁴

The predictions of these influential studies and others in the early 1990s, including one by the National Science Foundation that there would be a shortage of scientists in the second half of this decade, have not come to pass. In addition to faulty analysis of existing data, these erroneous predictions attest to the difficulty of making projections of this kind, as unforeseen events, including the end of the Cold War, economic changes, and changes in retirement laws altered in unanticipated ways the underlying models upon which the predictions were based.

In fact, the growth of faculties at institutions of higher education had leveled out through most of the 1970s and 1980s. But the number of students earning doctorates annually has grown by 27% in the last decade, from just over 31,000 in 1986 to almost 40,000 in 1994. Even more significantly, the number of doctoral programs has increased, as has the number of institutions offering doctoral degrees. While in 1989, 458 institutions offered the doctorate, by 1993 more than 650 institutions offered it. Furthermore, in fields for which in the past professional doctorates were the norm, there has been a shift to Ph.D. degrees.⁵

³ Bowen, William G. and Sosa, Julie Ann. *Prospects for Faculty in the Arts and Sciences*. Princeton: Princeton University Press, 1989.

⁴ Bowen, William G. and Rudenstine, Neil L. *In Pursuit of the Ph.D.* Princeton: Princeton University Press, 1992.

⁵ Haworth, Jennifer Grant. "Doctoral Programs in American Higher Education," *Higher Education: Handbook of Theory and Research*, ed. John C. Smart, pp. 373-421. New York: Agathon Press, 1996.

The growth of these programs has been accompanied by dramatic shifts in the population attending graduate school, with significant increases in the number of women, minorities, and foreign students.

In 1995 a joint committee of the National Academy of Sciences and of Engineering and the Institute of Medicine issued a report entitled *Reshaping the Graduate Education of Scientists and Engineers* (the COSEPUP report).⁶ This important report addressed a broad range of policy questions which affect the quality and vitality of graduate education in the sciences and engineering in our nation. Many of the questions considered by the committee are identical to the set of Institutional Policy Questions recently posed by the AAU Graduate Education Task Force on Institutional Policies, and many of the COSEPUP report recommendations for the sciences and engineering have direct relevance to the other major fields of graduate education. The report makes three main recommendations: (1) to increase employment opportunities, graduate programs need to encourage greater versatility by providing options that allow students to gain a wider variety of skills; (2) graduate programs need to provide better information and guidance to students; and (3) representatives of government, universities, industry, and professional organizations should begin to engage in reconsideration of the goals, policies, conditions, and unresolved issues pertaining to graduate education.

In many ways, the recommendations of the COSEPUP report represent an incremental, commonsense approach to dealing with complex issues in the areas of enrollment, curriculum, and employment. It is notable that COSEPUP rejected more radical solutions like the imposition of enrollment quotas. One reason for this is the difficulty encountered in quantifying needs. For example, despite the perception that the employment market for newly minted Ph.D.'s in the sciences is tight, the actual unemployment rate in 1993 was 1.6% for all scientists and engineers with Ph.D.'s and 2% for recent Ph.D.'s. This compares favorably with rates among other groups, including general professional occupations.

COSEPUP made a number of national policy recommendations which are likely to be implemented. Federal funding agencies may expand resources for graduate traineeships in the sciences, at a cost of decreased support through traditional federal funding mechanisms for graduate education. This will present Rutgers with new opportunities, but significant obstacles to overcome. Perhaps the single most important recommendation of COSEPUP can be summed up by the guideline that graduate schools should follow the principle of "truth in advertising," meaning that graduate schools must do more to inform prospective students about the amount of time they will be required to spend in graduate school, the skills that they can expect to learn, and the likelihood of obtaining appropriate employment at the conclusion of their graduate education.

Whatever the trends in graduate school enrollment portend as we approach the turn of the century, the competition among senior research universities for the very top graduate students will continue to intensify. We have developed a set of recommendations which we believe will strengthen Rutgers' ability to compete successfully for these students and to provide them with the best possible graduate education. The concerns raised by the COSEPUP report regarding problem areas in graduate education are echoed throughout this report as we have examined the situation at Rutgers.

⁶ *Reshaping the Graduate Education of Scientists and Engineers*, National Report of the Committee on Science, Engineering, and Public Policy (COSEPUP), Academy of Sciences. Washington, D.C.: National Academy Press, 1995.

INSTITUTIONAL PLANNING AND ASSESSMENT

Strategic Planning

Enhancement of graduate education in any institution requires ongoing processes of self assessment and institutional planning. In June 1995, Rutgers adopted a broad-ranging strategic plan, entitled *A New Vision for Excellence*, that charts a course for the university through the first decade of the new century. The plan outlines the responsibilities and challenges that Rutgers faces as New Jersey's state university, it identifies Rutgers' many existing strengths on which we should build, and it commits Rutgers to the ambitious goal of being in the top quartile of the nation's top-ranked public research universities by the year 2010.

As New Jersey's only comprehensive public research university, with campuses in northern, central, and southern New Jersey, Rutgers is the flagship institution in New Jersey's higher education system. New Jersey's economic and social well-being is closely tied to the health and vigor of its highly skilled work force. To support that health and vigor, the university needs to provide access to lifelong quality education; respond to the needs for scientific and technological advances; stimulate the economy and provide New Jersey industries with a competitive edge; and fulfill the service needs of the citizens of the state in an increasingly diverse democratic society.

As part of the planning process, the *University Strategic Plan* defined the criteria on which to evaluate and prioritize academic program proposals. These criteria are excellence of programs; centrality to our tripartite mission of academic instruction at the undergraduate and graduate levels, scholarly research and contribution to knowledge, and public service as a state university and land-grant institution; diversity in student, faculty, and staff recruitment, in curricular and cocurricular development, and in college life programming; and responsiveness to emerging needs.

The *University Strategic Plan* identified specific broad areas for academic growth in instruction and research, designed to build on existing strong programs on all three Rutgers campuses. These academic areas are:

- Liberal arts and sciences
- Cognitive science and neuroscience
- Creative arts
- Engineering
- Environmental sciences
- Gender studies
- Information science and related fields
- International studies
- Life sciences and agriculture
- Professional studies:
 - Business
 - Education
 - Health and behavioral sciences
 - Public policy and law

In 1995–96 over 250 faculty in 13 university-wide faculty committees, representing the priority areas identified in the *Strategic Plan*, assessed several hundred proposals received from faculty on all three campuses. Each of the committees evaluated proposals and developed an implementation report, which includes a vision for the future and outlines specific priorities for achieving greater excellence in our academic programs. The process is ongoing, with faculty committees responsible for developing high-priority programs and the external resources to support them. With faculty input the university is reallocating internal resources, developing proposals for funding from federal, state, foundation, and industrial sources, and preparing for a major capital campaign.

The strategic planning process identified those projects most critical to the university's mission and growth. These priority areas for strategic investment include:

- Undergraduate education
- Graduate and professional education
- Program support and development, including academic program development and development of centers, bureaus, institutes, and collaborative research faculty development
- Academic support systems
- Programs linking research with public service
- Initiatives that foster diversity
- Enhancements in buildings and facilities.

An executive committee, the Committee for the Future, has general oversight responsibility to advise on the implementation of the *Strategic Plan*. Membership on this committee is broadly inclusive, representing both senior faculty and academic administrators in arts and sciences and professional fields on all three campuses of the university.

In spring 1997 the university conducted a strategic resource and opportunity analysis, designed to identify some of our limited administrative resources for reallocation to support the academic initiatives recommended in the implementation committee reports. Approximately 40 key projects have been allocated a total of \$4 million to “jump start” their work. Each of these projects is using its allocated resources to leverage additional external resources for ongoing program funding. As strategic planning continues, the faculty are actively engaged in fostering the growth areas through support of the university's upcoming capital campaign and through proposal development for federal, state, foundation, and industrial funding resources.

Program Assessment and Oversight

The university's external review process is another key element of its assessment and accountability efforts. In the last 15 years this process has played a major role in enhancing the faculty's commitment to quality undergraduate and graduate programs and research. The first phase of the review process is similar to practices found nationwide at the best research institutions, and includes self-studies, on-site evaluations by external reviewers, program responses to external review reports, and close scrutiny of reports by senior administrators.

At Rutgers the process is enhanced significantly by involvement of a special presidential committee, the Committee on Standards and Priorities in Academic Development, composed of distinguished faculty from all three campuses, representing diverse areas of expertise. This group plays an integral part in the review process, advising on the charge to reviewers, meeting with reviewers, and formally assessing all documents

relating to each review. Since its inception in 1981, the committee has evaluated over 130 different programs on a cyclical basis. While it began with a charge to evaluate graduate programs exclusively, it now also assesses undergraduate programs; centers, bureaus, and institutes; and clusters of related units. Committee evaluations and external review reports are used by senior administrative officials at the university to identify key strengths and weaknesses, to determine resource needs, and to develop effective plans for program improvements.

Over time, this faculty body has developed expertise on program strengths and weaknesses, and has been able to provide insights regarding general curricular issues that external reviewers, themselves affiliated with the fields they are assessing, are not able to provide. Specifically, the committee is able to make recommendations regarding curricular specialization, appropriate coverage in disciplinary programs, and overspecialization. With their diverse backgrounds, the committee members are well aware of the pressing need for the technical knowledge associated with research advancements, particularly in science and engineering fields. They are also aware, however, that overspecialization can produce graduates who are ill-equipped to respond to the rapidly changing work environments they will face in industry, the public sector, or in academia. Their broad perspective, coupled with their appraisal of individual programs, provides the university with sound information on which to make policy decisions.

In addition to responsibilities for program reviews, this faculty committee serves as a key advisory body to the president on academic issues. By undertaking its own fact-finding missions, it has been able to provide the central administration with information and policy recommendations on critical issues, such as the relationship of centers, bureaus and institutes to academic departments, organizational support for multi-disciplinary research initiatives, policy regarding university libraries and information services, and Rutgers' status vis-à-vis other institutions, particularly its peer AAU public universities.

TRENDS IN GRADUATE EDUCATION

Acquisition and Dissemination of Information

In preparing the report on graduate education at Rutgers, we are faced with a series of policy questions. Are we training the right numbers of scientists, social scientists, and humanists? Is our training system efficient: that is, are we taking too long to graduate our students and are they learning material which is well matched with their postgraduate employment requirements? Are our graduate students receiving sufficient financial support so that they may complete their graduate studies in a timely fashion without seeking additional employment while working on their dissertations?

It is essential that a variety of statistical data be available in easy-to-comprehend form in order to develop well informed answers to questions about appropriate numbers of students in our programs, time to degree, matching curricula with postgraduate employment, appropriate financial support, etc. One of the major recommendations of the COSEPUP report is to establish more timely and accessible databases containing information about graduate education and employment. The ability of the institution to make timely decisions concerning the investment of its resources for graduate education so as to enhance its reputation for intellectual excellence—and/or respond to market forces—depends on the quality and availability of this information. Having experienced difficulty in obtaining needed data at Rutgers, we urge better communication among offices responsible for gathering and analyzing information, and more focused attention on what data collection needs are now unmet. We urge the Rutgers administration to devote the resources necessary to improve databases and data analysis capabilities at Rutgers.

Rutgers data summarized in this section were drawn largely from two sources: the Office of Institutional Research and Academic Planning, which includes data from all three campuses, and reports produced by the Graduate School-New Brunswick. Because of the complexity of our graduate and professional programs, for this report we use focused examples, rather than exhaustive description of all programs. While many of these examples refer to New Brunswick, the key points and recommendations of the report apply equally to programs on all three campuses. In some instances it has been difficult to obtain consistent numbers from these sources; for example there are wide variations in the reported elapsed “time to degree” (TTD) which we are unable to explain. We recognize that this is due for the most part to a lack of sufficient resources to develop appropriate databases. Data concerning national trends in graduate education were taken primarily from the early data release of the 1995 CGS/GRE Survey of Graduate Enrollment, Council of Graduate Schools, December 1996. Additional data on national trends were obtained from the 1995 COSEPUP report.

Summary of Statistical Trends

We issue several caveats concerning the tables in the appendix which present statistical trends in graduate education at Rutgers during the last decade. For some categories—e.g. total enrollment, and graduate degrees awarded by major field—we used raw data for three points in time, 1986, 1991, and either 1995 or 1996. For data concerning applications, admitted, and enrolled students we used raw data for the time period 1992–96. For each of these categories, we calculated percentage growth (or contraction) by dividing the most recent number by the earliest number available. Unfortunately, we were not able to obtain some important information because of the way data are gathered and categorized. For example, we are interested in the ratio of full-time to part-time students. In 1995 the total number of graduate students enrolled in the arts and humanities, sciences, and engineering combined for all three campuses was 4,392. Of these 1,844 were identified as full-time and 2,548 as part-time. However, these designations reflect the tuition status of these students, not whether they are working full-time in their graduate programs. Since most students who are pursuing the Ph.D. have reduced tuition obligations after completing a minimum number of required credits, we are not able to determine precisely what fraction of students is actually engaged in full-time study. Furthermore, the enrollment and application data do not differentiate between those students pursuing the Ph.D. and those pursuing a terminal master’s degree. While about half the engineering students are in master’s programs (321 out of 654), a smaller proportion of arts and sciences students are. Since we did not have reliable numbers for the total graduate student population in the arts and humanities, the sciences, and engineering who in practice are pursuing their Ph.D. studies full time, we were not able to make reliable estimates of the fraction of these students who are financially supported by Rutgers. We believe that the institution needs to have data on the percentage of students fully supported, and we urge the administration to take appropriate steps to obtain these reliable measures and track this kind of information on a regular basis.

Enrollment

With an annual growth rate of 2%, there was a 22% increase in U.S. graduate student enrollments between 1986 and 1995. Graduate enrollments at the 88 Research I institutions in the U.S. grew at only half that rate during the same ten-year period. By and large the growth of graduate programs at Research I institutions has been planned in coordination with the developments in infrastructure and institutional resources needed to maintain quality.

By 1995 only approximately one-third of the total graduate student body in the U.S. was enrolled at Research I institutions. Unfortunately, the development of graduate programs at smaller institutions has not

been supported consistently with the requisite development of infrastructure and resources at those institutions. As the NRC data clearly indicate, Research I institutions produce more Ph.D.'s per program than other Carnegie Classification categories, have greater library resources and expend much more money on them, have much higher numbers of faculty participating in each program, and have higher percentages of graduate students who have assistantships as their primary means of support. These differences have significant national implications for graduate education: namely that with respect to available resources, senior research institutions are in a significantly better position to offer high-quality graduate education than are institutions that are smaller in size and offer few graduate programs.

Trends in U.S. graduate enrollment by major field were fairly steady between 1986 and 1995. For the arts and humanities, sciences and engineering as a whole, the cumulative growth for the ten-year period was 16%. Surprisingly perhaps, arts and humanities experienced the largest cumulative growth between 1986 and 1995, growing by 34%, while there was no growth in the number of students enrolled in physical sciences and mathematics programs during the same time period. By 1995 graduate student enrollment in the U.S. was distributed approximately equally among arts and humanities, physical sciences and mathematics, social and behavioral sciences, and engineering (about 20–22% in each area), and somewhat less in the biological sciences (14%). In 1995 70% of all graduate students in this country pursued their education at public institutions, and more than half of them were enrolled in professional schools.

Trends in Rutgers graduate enrollment by major field between 1986 and 1995 are shown in Table 1. Overall the cumulative growth at Rutgers during this ten-year period for the five major fields which are the focus of this report was 15%, very close to the 16% national average for Research I universities. In line with national trends, the major field that experienced the largest growth at Rutgers was the arts and humanities, which grew by 46%, significantly greater than the national growth rate of 34%. The biological sciences at Rutgers experienced a net decrease in enrollment of 9% for the ten-year period ending in 1995. This is due at least in part to the sharp contraction of a master's program in Microbiology during this time period. Engineering enrollments also experienced a slightly slower rate of growth than the national average between 1986 and 1995 (6% at Rutgers, versus 10% nationally), while the physical sciences and mathematics experienced a greater growth than the national average (18% at Rutgers versus 0% national), and the growth in the social and behavioral sciences at Rutgers (20%) was close to the national average. At Rutgers almost half the growth took place in the arts and humanities, while enrollments in the biological sciences declined.

Applications, Admissions, and Degrees Granted

While the cumulative growth in annual applications to U.S. graduate schools between 1986 and 1995 has been significant, for the most recent one-year period for which national data are available (from 1994 to 1995), the overall rate of growth in new enrollments averaged over the five major fields was 1%, half the annual rate of increase during the past decade. Nationally, applications to graduate school decreased between 1994 and 1995 in each of the major fields except biological sciences, with the greatest decrease (6%) in applications in the arts and humanities. This suggests that graduate enrollments are in a period of flux, perhaps in response to the rapidly rising costs associated with graduate education, coupled with dire predictions in the popular press about job shortages in academia.

Table 2 shows the trends in Rutgers graduate applications, admitted, and new enrollments for the period 1992–96. While we do not have national data for this time period with which to make direct comparison, some parallels can be drawn with the 1994–95 national data. Considering the period 1992–96, and averaging over the five major fields at Rutgers, applications to the graduate school declined by 19%,

admissions declined by 24%, and new enrollments declined by 34%. The declines at Rutgers appear to be more severe than the national figures, based on extrapolation of the 1994–95 national data. The smallest decrease in new enrollments at Rutgers for the period 1992–96 was in the arts and humanities (23%), while the largest decrease in new enrollments (44%) was in the social and behavioral sciences. It should be noted that the New Brunswick graduate program in history experienced a large decrease in new enrollments because of a decision to limit matriculation to students who could be fully funded. For the physical sciences and mathematics, the decline in admissions during the period 1992–96 was significantly smaller than the decline in applications, perhaps an indication of some decrease in selectivity. The reverse trend was identified for the social and behavioral sciences.

Graduate degrees awarded in the U.S. increased by approximately one-third in the period 1986–95. Approximately 70% of the Ph.D.'s and 47% of the master's degrees were awarded in arts and sciences and engineering. These numbers indicate that doctoral education continues to be primarily the domain of arts and sciences programs, while master's degrees remain primarily the domain of the professional schools.

At Rutgers, the number of Ph.D.'s awarded during this time frame increased at twice the national rate. In the arts and humanities and in engineering, the number of Ph.D.'s granted increased more than 200% between 1986 and 1996 at Rutgers, and more than 100% in the physical sciences and mathematics. There was a small increase in the social and behavioral sciences and a decrease in the biological sciences (see Table 3).

Time to Degree

TTD, while affected by many factors, is nonetheless an important indicator of how well a graduate program is fulfilling its mission. On the one hand, the inherently greater complexity of some disciplines, and the exceptionally high standards for original scholarship of some departments, may tend to lengthen the TTD for “noble” reasons. More often than not however, longer TTD can be traced to a lack of adequate supervision or financial support, bleak postgraduate employment prospects, or deficiencies in students' preparedness for graduate school. The 1995 NRC Report provides strong evidence that in many disciplines the strongest graduate programs have shorter TTDs than the weakest ones.⁷

The COSEPUP report summarized data regarding the time required to attain a graduate degree in science and engineering. The median number of years between receipt of the bachelor's degree and a doctorate in science and engineering has increased from 7.0 years during the 1960s to 8.7 years for those who received their doctorates in 1991. Graduate students in the physical sciences have shorter-than-average overall completion times—about 7 years—and social scientists have longer than average completion times—about 11 years. The median time registered in doctorate programs was 6.7 years for those who received their doctorates in 1991; this excludes time taken off during graduate school.

There is a considerable discrepancy between the NRC report on TTD and the self-report data from the Graduate School–New Brunswick. (See Table 4 for a comparison of Rutgers–New Brunswick, AAU Publics, and U.S. averages, and Table 5 for selected self-report data from the Graduate School–New Brunswick.) In most fields the median time for receiving a Ph.D. at Rutgers is greater than the AAU average and even the national average. The arts and humanities at Rutgers have with the longest TTD, a median of over 13 years, two years longer than the average for AAU publics. For arts and humanities

⁷ Cited in note #1.

programs at Rutgers–New Brunswick the self-reported times are close to 50% shorter than the times reported by the Office of Institutional Research and Academic Planning. To a limited extent, the discrepancy between the two tables may reflect a very recent reversal of a long-term trend toward longer times to degree, assuming that the self-reported data is limited to the last few years. This would be a very welcome sign. However, there is reason to be cautious about self-reported data because of variations in the criteria that individual departments apply to determine how to count TTD.

Quality of the Students

Graduate programs have numerous more or less quantifiable measures of quality available to them. The relevant measures of the quality of the student body include undergraduate grade-point averages, scores on standardized admissions tests (GMAT, LSAT, etc.), the quality of source schools, and geographic diversification of the class. Another indicator of quality is “yield,” the number of admissions offers that are required in order to result in a matriculated class of the desired size—the smaller the number of offers, the stronger the apparent reputation of the school. In arts and sciences programs, the financial adequacy of support for doctoral students is a key indicator of program quality (and, at the same time, a key stimulus to improving the student body). For professional postbaccalaureate programs, the adequacy of scholarships plays an equivalent role.

The mean GRE scores for entering students in most programs at Rutgers are on a par with the AAU averages, according to the 1994–95 Annual Accountability Report for the Graduate School–New Brunswick. In most fields, the quality of entering students, as measured by grade-point averages, GRE scores, and program-selectivity, rose in the late 1980s and the early 1990s as the reputation of the university as a major research center grew, and as most graduate programs in New Brunswick concentrated on doctoral rather than master’s programs. As the Accountability Report indicates, this upward trajectory flattened out recently, with increased competition for students from universities that Rutgers had not previously been in serious contention. Nonetheless, the majority of our programs became more selective even in the most recent years prior to 1995–95 (16 programs became more selective— some substantially—while eight became less so).

Rutgers graduate students have become increasingly competitive in winning national fellowships. The Graduate Accountability Report (1994–95) lists over 100 awards from such governmental and private institutions as USIA, NSF, NIH, and the Fulbright, Kress, Pew, Ford, and Rockefeller Foundations, the Charlotte Newcombe and Alfred Sloan Fellowship funds, and several funding agencies associated with foreign governments (e.g., Canada, Germany, Turkey, Brazil). Thirteen graduate students won Harris fellowships particularly targeted to gifted minority students. Additionally, because of strong ties to Central and Eastern Europe established by some of our faculty, Rutgers now has 15 students on campus supported jointly by the Soros Foundation and the Central European University in Budapest.

Another measure that might be used to determine the quality of the students in the graduate programs at Rutgers by major field is the award of fellowships, particularly excellence fellowships, by the Graduate Schools on each of the campuses. In 1995, the arts and humanities were awarded one-third of the excellence fellowships and about 40% of all the (state) fellowships. This issue is discussed more fully in the section on financial support for graduate students.

Foreign Nationals

According to the Council of Graduate Schools survey, non-U.S. citizens account for 13 % of the graduate enrollment at Doctorate-Granting institutions and 20% of the enrollment at Research I

institutions. Two fields, engineering and the physical sciences, have the highest percentages of non-U.S. citizen graduate enrollment, at 36% and 32% respectively. The proportions are likely to be higher at Research I institutions. The number of science and engineering doctorates earned by foreign nationals in the U.S. more than doubled between 1983 and 1993 and accounts for most of the net increase in doctorates awarded in these fields.

Table 6 lists enrollment figures for international students in graduate programs on all three campuses of the university by major field in 1994–95. There were a total of 1,184 non-U.S. citizen graduate students enrolled in 1994 with the majority studying engineering, the physical sciences and mathematics. We believe the proportions at Rutgers to be higher than 50% throughout the physical and biological sciences, and in engineering and mathematics. In several departments the proportions are much higher; for example in chemistry–New Brunswick, 78% of the full-time students were foreign in 1996; in mathematics and physics in New Brunswick, close to three quarters of the Ph.D. students were foreign. While the College of Engineering reports only about half of their Ph.D. students are foreign, the data provided by OIRAP suggests that the proportion is higher than that.

What are the implications of this percentage of foreign students in our graduate programs? While foreign nationals contribute to the success and indeed to the very existence of many of our programs, there are some attendant problems that need to be addressed. One key issue is student quality. How can we ensure that the foreign students we admit are well prepared for our graduate programs? There is anecdotal evidence to suggest that GRE scores reported by foreign nationals from some regions of the world are less strongly predictive of future success in graduate school than these scores are for American students. We note the difficulty in identifying the most promising foreign applicants to graduate school using traditional measures such as standardized tests. This poses a considerable problem for those departments in the sciences and engineering which rely heavily on GRE scores for their selection criteria. Foreign nationals may have serious problems even if they are well prepared academically. Because of cultural and language difficulties, they may be less effective in the classroom as teaching assistants, and they may have added difficulties finding permanent employment.

More can and must be done to identify and recruit the best graduate students, both U.S. citizens and foreign nationals. This means we need to enhance our formal and informal networks with foreign universities to encourage applications by highly qualified students. At the same time, we need to be cautious about overrepresentation from any one geographical area; if departments rely very heavily on recruiting students from a single region, the resultant lack of diversity in the graduate student population can further limit efforts to recruit the best graduate students regardless of their national origin. Finally, we need to enhance programs to reduce cultural and language difficulties which may interfere with success in graduate work and with effectiveness as teaching assistants

U. S. Students

While a number of observers have noted the increased proportion of foreign nationals in our graduate programs, particularly in the sciences and engineering, most have ignored the corollary. The paucity of U.S. graduates in the sciences who are interested in pursuing advanced technical degrees in science and engineering, and who are adequately prepared to pursue these degrees, poses a critical problem in American higher education. Though a number of AAU institutions, including Rutgers, would like to increase the number of American graduate students in their programs, they recognize that this is difficult because of the intense competition for such students by the best schools, and more important, because the pool of potential students is so small. Some universities are now putting more emphasis on attracting

stronger U.S. students. This trend is accelerating nationwide, due to the rise in national (NSF and DOE) fellowships and traineeships that are only open to U.S. citizens and permanent residents. To the extent that we are concerned about future doctorate-trained American scientists, we need to focus significant attention on science training at the undergraduate level, and indeed, to be effective in that sphere. We also need to devote university resources to the enhancement of science and mathematics education in K–12 to prepare future students to succeed in science and mathematics.

Quality of the Faculty

A key finding of the 1995 NRC Report on Research Doctorate Programs in the U.S. is that more-productive faculty are associated with higher quality programs. Faculty recruitment is critical. To become a recognized leader in an important area quickly, a program can of course make highly visible senior appointments. However, for most institutions, a more realistic and ultimately more successful strategy is to appoint outstanding junior faculty and then mentor and encourage them to become world leaders in their respective fields. Retaining the best faculty is also critical for the growth and continuity of graduate programs. The reputation of the faculty is a necessary, though not sufficient, component in recruiting and graduating the best qualified students. The quality of Rutgers' faculty increased significantly in the last 15 years, as indicated in the NRC ratings. Average ratings at Rutgers–New Brunswick are higher than the averages for all AAU publics in all arts and sciences fields, with the highest ratings in the physical sciences and mathematics. (See Table 7.)

Trends in tenure-track faculty lines at Rutgers are presented in Table 8. Between 1986 and 1995 there was a 7% decline in the number of tenure track lines in arts and sciences on all campuses. The combined Faculties of Arts and Sciences and Engineering on all three campuses (~1,100) constitute approximately 50% of the full-time faculty at the university (~2,200). Data on the total number of full-time faculty at Rutgers by rank are presented in Table 9.

Postgraduate Employment

The ability to place graduates in professional positions is one important measure of program quality. It is equally important, however, to take a fairly long view here because professional jobs are inevitably tied to economic cycles, and the enduring quality of a faculty, its curriculum, and its research, can be harmed by responding too quickly to short-term changes in the job market. Rutgers should move slowly and with considerable deliberation in changing degree programs, especially with respect to closing down programs in the arts and sciences that have been central to the institution's mission, or in creating new interdisciplinary degree programs that are responsive to short term market needs, but have not proven their long-term worth. In order to accommodate the needs of rapidly emerging postgraduate employment opportunities, institutions should allow programs the internal flexibility to redeploy existing resources in innovative ways, without making long-term institutional commitments for new resources.

Infrastructure

The state of an institution's infrastructure is a powerful indicator of program quality and progress. While it is abstractly possible to run a world-class program out of a third-rate facility, neglect of surroundings more often than not accurately bespeaks neglect of the program itself. This is literally true with respect to direct support of teaching and scholarship: without adequate research collections, staff support and—in today's world—computing, word processing and communications technology, improvements in the quality of the program become very difficult. The relationship is also true, however, even in a less literal sense. A shabby building, email that doesn't get through, and so forth, communicates to the outside world of peers that the program is neglected.

Rutgers' plans for RUNet 2000 will go a long way to provide the electronic systems necessary for today's communications. Because of the rapid changes in communications technology, however, we must continually assess our needs and provide appropriate resources. Rutgers should also address the chronic problems of older buildings and instructional and research facilities. The university needs to continue to seek funding for deferred maintenance of its physical plant.

GRADUATE STUDENT ISSUES

Students face major problems in completing their graduate studies and universities need to address these issues. While the experiences of students in different fields of study may be quite divergent, graduate education poses significant challenges to all of them. Students come to top ranked programs because these programs offer cutting-edge research, a wide variety of specializations, theoretical rigor, and/or nontraditional programs

The TTD is a crucial factor for all Ph.D. students. The preparation of the dissertation is only one component of graduate work. It should be an important experience in conducting research, conveying the results of that research to the world, and learning how to make an impact. But the very narrow focus of the research program means that the student is ill-served if the research project goes on indefinitely. Students should be encouraged not only to finish in a timely fashion but also to broaden the scope of their projects, and to explore a greater number of avenues for research. To that end, the Ph.D. research project should have carefully delimited boundaries so that completion is feasible in a reasonable amount of time. A number of programs are experimenting with different plans for degree completion, including the substitution of multiple published articles for the single dissertation report. These innovative approaches should be explored, as long as there are safeguards to ensure that students have adequate experience in research, analysis, and communication of results.

While TTD is obviously affected by the amount and type of support students have, the less tangible support of peers and faculty members is equally critical. Students at the dissertation research stage should have committees, comprised of faculty and perhaps other students, with whom they meet on a regular basis, whether or not significant progress on the thesis has been achieved. This regular feedback can help avoid the all-too-frequent isolation of the graduate student, a condition which only serves to delay further the completion of work.

In all fields, universities need to ensure that graduate students get sufficient training and experience in teaching to enable them to assume responsibilities as instructors upon graduation. Of course, graduate students also provide crucial strength to undergraduate teaching programs. As our understanding of pedagogy has progressed, we can no longer claim that future professors can just learn to teach as they practice on students. Universities expect that candidates for instructor and assistant professor positions have had teaching experience and can demonstrate their abilities in the classroom. At Rutgers their preparation to serve as effective instructors takes various forms, including general orientation workshops, participation in the Graduate School–Teaching Assistants' Programs sponsored by the Graduate Schools in Newark and New Brunswick, development of teaching portfolios, teaching awards, and especially training sessions developed by individual graduate programs. In fall 1994, the Graduate School–New Brunswick gave its first teaching awards for graduate teaching by faculty members, and for undergraduate teaching by graduate students.

Profiles of Graduate Education in the Humanities, Social Sciences, and the Sciences
Humanities and Social Sciences

In the humanities and social sciences, the critical issues include: the long, drawn-out process of formulating the dissertation topic and completing dissertation work; the low level of financial support; the heavy workload for TAs; and the poor job market. When students' course work is completed and their comprehensive exams are behind them—usually in their third or fourth year—the process of defining and writing a dissertation is a lonely one. Though it is done in consultation with an advisor and a committee selected by the candidate, many students do not feel sufficiently supported by their mentors at this stage. For those who support themselves as TAs, the time becomes extended even further, especially in those programs which require autonomous teaching in writing and literature courses. The reliance of many departments on graduate students to teach sections of undergraduate core courses (especially writing) can further compromise the graduate school experience of students in the humanities and social sciences. Though most program faculties make a sincere effort to help students on the job market—assigning faculty placement officers, helping candidates assemble dossiers and draft letters of application, giving practice interviews, contacting colleagues at other universities that have expressed interest in particular applicants—the process could be improved considerably.

For all of our graduate students the issue of mushrooming costs is a critical issue. For the humanities and social sciences, it is especially important because sources of government support for graduate education have traditionally been so much smaller than for the sciences. Successfully training the next generation of scholars in the humanities and social sciences will require us to look hard at our escalating tuition costs, and at the implications of postgraduate debt on recruitment of potential graduate students, on choices within graduate programs, and on choices and options in postgraduate employment. At some institutions, including Rutgers, conscious decisions to limit graduate enrollments in key fields to those students who can be fully funded is one approach to this problem. Other avenues also need to be explored.

The job market crisis is the greatest concern for graduate students in the arts and humanities at this time. While some departments have tried to respond to these problems, more energy is demanded in this area. In particular, programs should be as frank as possible to prospective students about the job market, disclosing with precision such matters as TTD and information about job placements of recent graduates. Programs also need to cultivate contacts with nonacademic institutions—industry, consulting firms, etc.—that need employees with the analytic and research skills which Ph.D. students have in abundance. Intellectual support and collaboration, as well as fellowship support, during the dissertation stage, which is common in many science areas, should be more widespread in the humanities and social sciences. All programs need to guard against overspecialization and to nurture, where appropriate, the kinds of cutting-edge interdisciplinary programs that can provide a broader educational experience, in order to prepare students to compete successfully for jobs in new and rapidly developing fields.

The humanities and social sciences may learn something from the collaborative methods of their colleagues in the physical and biological sciences. In recent years the value of team approaches to problem solving has been shown in a wide range of learning environments. Humanities and social science graduate programs may benefit from experiments that formally group students with each other and with faculty mentors.

A graduate student in the humanities is required to complete between 14 and 16 courses, usually over the course of two to three years. The qualifying exams are taken once the coursework is completed, in the third or fourth year, and usually involve oral and written components. After passing the exams, the student picks a dissertation advisor and develops a dissertation proposal. After approval, the dissertation committee meets to discuss the proposal and direct and advise the student in beginning the project. Once the dissertation is under way, there is less formal structure to the committee, and the degree of involvement of the advisor and the committee varies greatly from case to case, depending on the personalities and needs of the students and the faculty involved. The work at this stage of the program tends to be solitary, and students meet infrequently with faculty and other students. Some students form dissertation groups with other students working in similar fields to counteract this intellectual isolation, and these groups can be extremely useful.

The majority of students in New Brunswick humanities programs receive five-year funding packages, including two to three years of fellowship and two to three years of TA or GA support. In the social sciences, political science awards only four-year packages. English and history have attempted, over the past five years, to distribute funding more equitably. In political science, only half the students in a given entering class are offered fellowships. The remaining half must apply for TAships on a yearly basis. A significant determinant for TTD is teaching. The TTD for students in history and political science is six to seven years; in English, it is seven to eight. The responsibilities of teaching assistants vary greatly.

What attracts graduate students to Rutgers' humanities and social science program is its outstanding faculty. Students feel that Rutgers is a stimulating place to be and that they have excellent opportunities to work with scholars whose work they admire. Rutgers–New Brunswick has the largest and highest-ranked women's history program in the country, and one of the only political science programs with a specialization in women and politics. The English program is also one of the best in the country for American, African-American, and feminist scholarship. Students enroll in these programs because they are "cutting-edge" and theoretically rigorous.

The Sciences

In the sciences there are different issues to address. Opportunities for collaborative and interdisciplinary research are especially important. Excellent opportunities for interdisciplinary graduate training are provided by graduate programs in Newark and New Brunswick offering a variety of funded programs, for example, NIH-funded Traineeship Programs in Molecular Biophysics and in Biotechnology; and NSF training grants in Cell and Molecular Biodynamics. Graduates of these traineeships are well prepared for the type of collaborative, interdisciplinary research and development positions in government and industry that are expected to become more and more important in the years ahead. Traineeships tied to industrial research and development are also important because they provide students with a firm understanding of the nature of industrial research and development.

While some graduate programs provide students with rotation opportunities coupled with sufficient time to develop in-depth research interests, other programs overly limit students' experiences. Sometimes this is expressed as faculty overdependence on graduate student help, particularly in research laboratories, and this can have a deleterious effect on graduate training. Faculty should not depend on individual graduate students to provide ongoing research/technical support; students need to be encouraged to complete their work and their graduate programs.

Although most concerns about graduate education and its relation to the research mission of the university are the same irrespective of academic discipline, some are confined to the experimental sciences. In contrast to the arts, humanities, and some social sciences, where strides in scholarship and research are made by the individual faculty member, experimental scientists work in a team with the undergraduate students, graduate students, and postdoctoral associates under their tutelage. Teaching is also defined in a broad manner and encompasses the time- and labor-intensive mentoring and training of undergraduate and graduate students and postdoctoral associates in experimental techniques and in the general scientific method.

A graduate student in the sciences is expected to complete a core of three to six basic graduate courses in the first year of graduate study and then typically takes more specialized courses in the second year. The Ph.D. qualifying exams consist of both written and oral components; some fields (for example chemistry and behavioral and neural sciences) include a presentation and defense of a research proposal. Science students are encouraged to select a thesis adviser and begin research as early as possible. For example in the New Brunswick program in chemistry and the molecular biosciences, a student is expected to select an adviser by the end of the first year in the program and to begin research that summer. In physics, a student normally identifies a research adviser in the second year in the program and begins research the following summer. There is a formal mechanism in all these programs to assist students in selecting an adviser, which typically includes a series of faculty research presentations for new students, and a requirement that students interview a number of faculty concerning possible research projects. The graduate director usually assigns the adviser based on a prioritized list of choices submitted by the student. In a number of programs, students participate in lab rotations; they spend one-half to one semester working on a small research project in a faculty member's laboratory and thus "trying out" the given research group.

While engaged in research, the student is supervised by a thesis adviser and frequently also by a postdoctoral fellow in the research group. Students in many of the experimental sciences work as part of groups and participate in weekly group meetings. They are expected to give presentations on the progress of their research at those meetings and to meet with their thesis committee once a year to discuss research progress. The extent to which this is followed in practice varies greatly.

Science students are supported by various combinations of teaching assistantships, fellowships, and (grant-funded) graduate assistantships. In chemistry and physics, TAs are the primary means of support and a typical student is supported as a TA for the first two to four years and then is supported as a GA on one of the thesis adviser's research grants. In the Molecular Biosciences Graduate Programs, students are supported as graduate fellows the first year, as TAs the second year, and as GAs thereafter. In physics, all students in good standing are guaranteed support for up to six years from departmental resources, whereas in chemistry, students receive a maximum of four years of TA/fellowship support from the department; after that they must be supported on their thesis advisers' research grants or be self-supported. TAs usually teach sections of introductory or advanced undergraduate laboratory courses. Total time spent on preparation, teaching, grading, office hours, proctoring, etc. is 12–15 hours per week.

The TTD is typically five to six years in chemistry and physics, and somewhat longer in the molecular biosciences. TTD is generally longer for students who are TAs for most or all of their graduate careers. Half to two-thirds of students take a postdoctoral position; the remainder find a position in industry directly upon graduation. Most students obtain a permanent position in industrial research and development, although 15–20% of the graduates in physics, for example, obtain tenure-track faculty positions.

Graduate students in the sciences are also drawn to Rutgers by the excellence of the faculty and the wide variety of research specializations available. In most graduate programs, there is a strong emphasis on collaborative and interdisciplinary research, involving collaborations among research groups within the program and collaborations with researchers in other departments and institutes at Rutgers and the University of Medicine and Dentistry of New Jersey. Excellent opportunities for interdisciplinary graduate training are also provided by a variety of NIH-funded Traineeship Programs (e.g., Molecular Biophysics, Biotechnology), the NIH-funded Minority Biomedical Research Support Grant, and the NSF-funded Research and Training Program in Cellular and Molecular Biodynamics. Students are thus well prepared for the type of collaborative, interdisciplinary research and development positions in government and industry that are expected to become more and more important in the years ahead. In addition, northern and central New Jersey have the highest concentration of chemical and pharmaceutical industry in the nation. Many faculty members in chemistry and the molecular biosciences interact frequently with industrial researchers in the area, providing graduate students with a firm understanding of the nature of industrial research and development.

The surveys conducted each year by the Graduate School–New Brunswick of those who have completed Ph.D. degrees indicate a high level of satisfaction with their education at Rutgers. Of 305 respondents in 1994 and 1995, for instance, 103 rated their experience “excellent,” and 162 “good,” 39 “fair,” and only seven “poor.” Nonetheless, it must be recognized that graduate students have causes for complaint. In the humanities these center on the long time it takes to formulate a dissertation topic and complete it, the level of financial support, the work load for TAs, and the poor job market. For students who support themselves as TAs, the time becomes extended even further, especially in those programs, such as English, which require autonomous teaching in writing classes of up to 22 students, and in literature courses. While the latter are much sought after, student-teachers nonetheless feel exploited when they compare their “apprenticeship” stipends to those of the full-time faculty. The poor job market also understandably creates low morale. Though most program faculties make a sincere effort to help students on the job market—assigning faculty placement officers, helping candidates assemble dossiers and draft letters of application, giving practice interviews, contacting colleagues at other universities who have expressed interest in particular applicants—the perception among some prospective and unsuccessful applicants is that faculty at prestigious Ivy League institutions “go to bat” more energetically on behalf of their top students.

There are a relatively large number of industrial jobs available in the sciences, but very few tenure track academic positions, and this is a source of discontent for some graduate students. Furthermore, while the TTD in the sciences is shorter than in other fields, it is common practice for science Ph.D.’s to take at least one postdoctoral position for two to four years before getting a permanent position. The prolonged period of uncertainty and the “temporary” status, first as a graduate student and then as a postdoctoral, are sources of anxiety for many.

Recommendations

Because the job market crisis is of great concern for graduate students, student morale would be improved by implementing a number of changes. Individual graduate programs should consider: maintaining and cataloguing lists of recent Ph.D. graduates and current positions; forming placement committees to provide general advice on career services; providing annual information sessions on preparation for diverse career options; developing joint industry/university initiatives to aid recruitment of graduate students and to acquaint aspiring scientists with career options (for example for chemists in the

pharmaceutical industry); and establishing initiatives to place graduate students in industrial internships. Of course, many programs already carry out these support services, but more can be done. Colleagues in the professional schools may have a great deal to offer arts and sciences faculty in the development of appropriate placement programs.

While the New Brunswick English program and others have tried to respond to the bleak job prospects in their disciplines, more energy is demanded in this area. In particular, programs should be as frank as possible to prospective students about the job market, disclosing with precision such matters as TTD and recent job placements. Programs also need to cultivate contacts with nonacademic institutions—publishing firms, industry, consulting firms, etc.—that need employees with the analytic and research skills that Ph.D. students have in abundance. Intellectual support and collaboration during the dissertation stage, which is common in many science areas, should be more widespread in the humanities and social sciences also. All the departments in the humanities and in the sciences need to guard against overspecialization and to nurture, where appropriate, the kinds of “cutting-edge” interdisciplinary programs that can provide a broader educational experience, in order to prepare students to compete successfully for jobs in new and rapidly developing fields.

In order to bring in the best graduate students, sufficient resources are needed to support their basic economic needs. On all three campuses of Rutgers, increased TA and GA stipends, health benefits for graduate fellows, and more married-student housing would substantially improve graduate student morale in both the humanities and the sciences.

The placement of students in the kinds of academic positions for which they have been educated is one of the most difficult issues for many programs. The current employment problem in academia is obviously a national one. But it leaves most programs with a challenge: how to train students for a greater variety of possible jobs, and in some cases how to achieve moderate downsizing while preserving the necessary “critical mass” of students to support a program of sufficient diversity and curricular breadth to be of value. It should be remembered, however, that the current employment situation may not be permanent, even with delayed retirements on the part of senior faculty nationwide, and that it would therefore be imprudent to jeopardize strong and effective programs.

More can and must be done to identify and recruit the best graduate students, both U.S. citizens and foreign nationals. The following university-wide recommendations are suggested: (1) additional fellowship support for the strongest students, (2) increased funding for departmental recruitment activities, and (3) a coordinated, large-scale recruiting initiative across relevant disciplines, such as mathematics, science, and engineering programs. With respect to a large-scale coordinated approach to recruiting, related departments on each of our campuses might consider sponsoring a common intensive recruiting period, culminating in a day when top potential recruits in all of the related fields are brought together to the university. The goal is to bring a critical mass of top students in at the same time, and to highlight the advantages of pursuing graduate education at that university. An energetic and successful recruiting effort will require a substantial investment of new resources. In addition to doing more to recruit top American students, more and better “scouting reports” are needed to recruit the very best foreign students.

Financial Support for Graduate Education

Reduced funding from both state and federal sources poses one of the most serious challenges to quality doctoral programs in America today. While many states are moving to performance indicators (ratios, percentages, or other quantitative values used in comparisons) to help inform public policy decisions about

resources to higher education, little attention is being given to the quality of programs being considered for funding. The failure to include discussions of quality in policy debates may condemn the U.S. to second-class status in the next century since so much depends upon our continued preeminence in research and the training of future scholars and applied scientists.

Graduate education is underfunded on all three campuses at Rutgers. This point is made emphatically in a report issued by the dean of FAS–New Brunswick in late 1996. “One issue on which there is total agreement among the unit, campus, and university strategic planning implementation reports written in 1995–96 is the vital need for improved systems of graduate support, especially those which support graduate training and research, and bring outstanding graduate students into the classrooms where their talents and enthusiasm are highly effective in undergraduate instruction.” As the *University Strategic Plan* noted, in 1993 the number of teaching assistant and graduate research assistant positions on all Rutgers campuses placed Rutgers in the bottom half of its peer group, other public AAU universities. As a major research university, Rutgers needs the wherewithal to attract the most able young scholars, competing with the leading universities in the country to do so.

There were a total of 1,574 positions supported through assistantships and fellowships on all three campuses in 1995–96 (Table 10). The arts and humanities and the physical sciences and mathematics had the largest number of supported positions (25% and 24% respectively). The number of lines awarded in the different categories of support reflect very different funding patterns. Students in the arts and humanities are supported overwhelmingly by state funds, whereas students in engineering and the biological sciences have a far larger proportion of support from grant-funded GA lines. The distribution of resources for graduate student support at Rutgers may reflect a variety of factors including: (1) the larger number of top students, particularly American students, in the arts and humanities and social sciences at Rutgers relative to the other major fields; (2) the more stringent competition nationally among Research I universities for top students in the experimental sciences; and (3) the more limited access of graduate students in the arts and humanities and the social sciences to federal funds in support of graduate education. The distribution of funds for graduate students is also affected by a trend in the sciences to use grant funds to support postdoctorals rather than graduate assistants.

The growth of graduate programs at Rutgers is tied to the way in which graduate support lines are distributed throughout the university. As Rutgers undergoes the process of review and reconsideration of the goals, policies, and conditions pertaining to graduate education, it is imperative that careful thought be given to the distribution of graduate lines, particularly state fellowships where more discretion in making awards is possible. In order to insure accountability, it is necessary that clear guidelines for prioritizing requests for support be in place. Insisting that awards meet the criteria for “excellence” has served Rutgers well for a decade and should remain a paramount consideration. The question of how and in what ways additional criteria related to postgraduate employment opportunities and trends are factored into award considerations needs further discussion.

First-year stipends for graduate students at Rutgers–New Brunswick are compared with some peer AAU public institutions in Table 11. Typically, stipends when calculated on a 10-month basis, are 10% to 20% higher at our peer institutions than at Rutgers. The Rutgers stipend is even less competitive considering that living costs in the New Jersey area are so high; graduate student housing costs at Rutgers have risen 34.8% since 1992–93, while the stipend, which has been frozen for the last two years, has increased only 11.2% in that time period.

Virtually every graduate program reports that it could attract students it is now losing if it had available more, and more generous, financial support packages. The point is confirmed in a large number of program reviews by the Committee on Standards and Priorities in Academic Development, which has advocated enhanced support for graduate students. We need more TAs and we need to increase the size of awards to be competitive. This is especially a problem in the sciences and engineering programs, but it also affects the humanities and social sciences. Currently the top fellowship awards at Rutgers are rarely more than \$12,000 per year without benefits; the University of Pennsylvania, to take an example of a major university in our geographic area, offers \$13,500. Since our most able students—including gifted minority students—are recruited by means of fellowships, the lack of benefits makes these awards less desirable than they might otherwise be.

Institutions need to reconfigure their own resources to maximize support for graduate education. This is especially critical for development at Rutgers because of the levels of graduate support offered by senior research institutions with which we compete for the best graduate students. One recent proposal for enhancement in graduate support, developed by FAS–New Brunswick, calls for flexible, wide-ranging enhancements of support university-wide. These enhancements include increased fellowship awards, matching of externally funded fellowships, and further targeted tuition remission. University-wide flexible support programs would have significant benefits, including: competitive advantages in recruiting the best graduate students; enhanced ability to accept foreign exchange students, who bring needed diversity; more resources for domestic students to go abroad for research relevant to their interests; and additional resources for matching funds needed for some externally funded fellowships, which are sometimes lost now because we do not have that flexibility. Such programs could also be attractive to potential donors, for whom the “adoption” of a graduate student fellow could be an attractive philanthropic option if not prohibitively expensive.

A major recommendation of the COSEPUP report is to increase federal funding for education/training grants in the sciences, an adaptation of the training grants awarded by the National Institutes of Health and other agencies. It is likely that this policy recommendation will be instituted. Such a policy shift could have a significant impact on the funding of graduate education at Rutgers. With respect to our peer AAU institutions, Rutgers currently has a relatively small number of graduate students on training grants. For example on the New Brunswick campus we currently have NIH graduate training grants in molecular biophysics and biotechnology, NIH grants to UMDNJ for students in our joint programs in Molecular Genetics, Pharmacology, Biochemistry, and Toxicology, an NSF training grant in pharmaceutical engineering, and a Whitaker Foundation grant in biomedical engineering. On the Newark campus, for example, we have an NSF-funded Research and Training Program in Cellular and Molecular Biodynamics. In most cases the award of fellowships is limited by the terms of the grant to U.S. citizens, and competition among senior research universities for the best American graduate students in science is fierce. While our training grants at Rutgers are very successful, we have encountered difficulty recruiting sufficient numbers of highly qualified American students. We need to expand the number and scope of federally funded graduate training programs at Rutgers. Equally important, in order to make our institution competitive, it is imperative that significant resources be allocated to recruiting the most promising students, that more coordinated recruiting strategies be developed, and that the faculties in the sciences devote their energies to this effort.

THE RESEARCH MISSION AND GRADUATE EDUCATION

The fostering of outstanding graduate education programs is critical for our research mission since it produces the next generation of outstanding researchers as well as teachers of subsequent generations. Graduate education also strongly supports ongoing research by university faculty. Outstanding graduate students and postdoctoral fellows provide vigor and vitality to our research programs, as they question old assumptions and bring new ways of thinking about research problems. Indeed, at the graduate level teaching becomes a reciprocal process for faculty and students. Moreover, in programs where the graduates move directly into the workforce, rather than going to other universities (most professional school programs, for instance), recent graduates are an important mechanism for disseminating the faculty's research and scholarship to the world of practitioners.

Areas of Excellence

Rutgers faculty are well represented in the prestigious national academies. Compared to other AAU public universities, our faculty rank 10th in number of members in the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the American Academy of Arts and Sciences.

The quality of faculty at Rutgers, as determined by the National Research Council and reported in *Research-Doctorate Programs in the United States, Continuity and Change*, 1995, is clearly higher than the national average and is comparable to that of the AAU public universities. The quality of our faculty from the following programs ranked at least 0.3 points higher (on a scale of 0 to 5) than the average for AAU public universities: English language and literatures, history, philosophy, physiology, computer science, mathematics, physics, and statistics and biostatistics.

Library holdings are commonly used as an additional indicator of quality of a research university; Rutgers was ranked 8th out of 30 in terms of total research library expenditures in fiscal 1994 and 16th in rank of total current serial holdings.

Funding of Research Activities

Nationwide, support for research and development in academia has been increasing in recent years. Data provided by the National Science Foundation for all combined academic institutions show total expenditures for R&D increased by 65% for the ten year period 1984–93. Nationally, the percentage of R&D expenditures from different funding sectors has remained quite stable, though changes in federal and institutional dollars (as percentage of total expenditures) have been complementary. Taken together, these two sectors provided a constant 78% of total R&D expenditures from 1989 to 1993.

Rutgers' external funding shows a clear upward trajectory from fiscal 1986 to fiscal 1996 for all sources of research and contract funding except for that originating from the State of New Jersey. The most significant increase has been in federal research and contract funding, with \$28 million in fiscal 1986 increasing to \$90 million in fiscal 1996. The university has also increased revenue from research and contract dollars from corporate sources and from foundation and other sources. Corporate research and contract funding rose from \$6 million in fiscal 1986 to \$14 million in fiscal 1996, and funding from foundation and other sources increased from \$4 million in fiscal 1986 to \$21 million in fiscal 1996. Research and contract funding dollars originating from the state of New Jersey have fluctuated from a low of \$15 million in fiscal 1986 to a high of \$29 million in fiscal 1989, and have remained at about that level

through fiscal 1996. As a consequence, the percentage of total research and contract dollars derived from state sources has decreased, while the percentage of support deriving from federal and foundation sources has increased. The percentage of research and contract funding from corporate sources has remained relatively steady.

At Rutgers support for research and development has been increasing, at a faster rate than it has nationwide. During the period 1984–93 total expenditures for R&D increased at Rutgers by 123%.⁸ Expenditures of federal funds for R&D at all combined academic institutions rose 57% from 1984 to 1993 and 13% from 1989 to 1993. In these same time periods, federal expenditures at Rutgers rose 97% and 31%, respectively. Among AAU public institutions in fiscal year 1993, Rutgers ranked 24th in federally financed R&D expenditures and 17th in total R&D expenditures.

An NSF survey of fiscal 1994 compared resources at Rutgers with those available at several peer institutions (Michigan State University, the University of Arizona, the University of Maryland, and the University of Virginia). Rutgers had comparable federal equipment dollars expended, total number of graduate students and postdoctoral associates, and numbers of institutionally-supported teaching assistants, but had fewer federal fellowships and training grants, and fewer graduate students supported by federal funds.

Comprehensive research universities are engaged in significant competition for very scarce resources, but it is not other research universities that pose the greatest threats. Indeed, competition in this arena has traditionally created higher standards and greater achievements in research and instruction. Today, research universities face an increasing challenge from smaller institutions that are ill-equipped to provide comprehensive graduate education. These institutions have developed a wide range of graduate and professional programs, and while a number of these programs provide badly needed educational services, particularly in underserved areas or to underserved populations, their presence has threatened the comprehensive universities in a number of ways.

First, program proliferation has meant that overly specialized, narrowly focused graduate programs are being marketed for potential students as “quick fixes” for employment concerns. The quality of the education offered and the narrow focus of the materials covered may contribute more to vocational problems in the future. Second, program proliferation, especially among public institutions, inevitably means competition for scarce resources from state and local sources. If small institutions become providers of advanced graduate education, they often cannot maintain the same standards, nor offer the same comprehensive services that can be offered by the long-established programs. By sharing this diminished pot of public resources, these small programs divert scarce resources and may threaten programs that have taken many years to develop.

No one university can offer its students all possible combinations of educational specialization. In order to provide excellence in its programs each university must make hard choices about what it can truly and

⁸ Note that there is not a direct correspondence between grants/contracts awarded and expenditures in a given fiscal year. A distinct lag time is seen between award and expenditure of funds. Rutgers reached a height of grant/contract awards in fiscal 1994; NSF data for expenditure of these funds has not been tabulated. In using the NSF data to compare Rutgers to other institutions, one must keep in mind that Rutgers was experiencing a strong upswing of external funding awarded during this period.

fairly support. If universities fail to make these decisions, constant battles regarding reallocations of limited resources will ensue, and program quality will inevitably suffer. Internally, an inequitable distribution of resources in the short run, targeted to those programs that are excellent or show the promise of developing excellence, is the most realistic strategy for enhancing quality over time. If the long-term projection is that resources will not be available to support all programs at the desired level of quality, then the hard choices should be made sooner rather than later, in order to ensure that there is appropriate support for those programs to which the university remains committed.

As universities target certain areas for development, they find themselves in a shifting field of reference for achieving national preeminence, and as they move up in national rankings they find themselves in competition with peers whose programs are also improving. In order to achieve success, universities must commit appropriate resources to high-priority programs. But success should remain tied to excellence; resources should be given to programs that are already the institution's strongest, or programs that could become significant centers of excellence with planned allocations of needed resources. Money alone will not buy success, but if lack of resources forces small—rather than definitive—steps in student recruitment, faculty accomplishment, and program infrastructure, lack of progress is virtually assured.

Postdoctoral Fellows

According to the recent National Academy of Sciences report, *Reshaping the Graduate Education of Scientists and Engineers*, there has been a significant increase in the proportion of recent Ph.D.'s (most notably in the biological and physical sciences) who are employed as postdoctoral associates. Additionally, the time spent in postdoctoral appointments has lengthened for these fields and can be as long as five to eight years. It is extremely rare for a research university to hire a biological or physical scientist as a tenure-track assistant professor unless that person has completed a postdoctoral associate appointment with a research mentor of the highest caliber and reputation. The merit and reputation of a faculty member's research program in the biological and physical sciences are dependent on the quality of these postdoctoral fellows, who are highly motivated to perform innovative, ground-breaking research, and who assist faculty in the research training of undergraduate and graduate students. Consequently, the manner in which postdoctoral associates are treated by universities is of great concern to faculty members in many fields, particularly in the experimental sciences.

Nationwide, postdoctoral appointments have proliferated, but critical support is frequently lacking. In fields in which professorships are in very short supply, some mechanisms should be developed to allow postdoctoral fellows to continue on their career paths. Annual appointments as research associates may help in this process, and university policies with regard to continuing appointments, salary, and benefits should be reviewed and updated regularly. In addition, pilot programs to reward exceptional postdoctoral associates should be considered. Special appointments should bestow honor and recognize the essential roles that the postdoctoral associate plays in furthering the research reputation of the university and in the training of undergraduate and graduate students. Such appointments may be appealing to potential donors who wish to support research in specialized fields.

We recommend that a pilot program be established at Rutgers to reward exceptional postdoctoral associates at the university. This should be a prestigious honor and should recognize the essential roles that the postdoctoral associate plays in furthering the research reputation of the university and in the training of undergraduate and graduate students. In addition, university administrative policies with regard to postdoctoral associate appointments should be reviewed and updated regularly.

Interdisciplinary Research Centers

Universities may need to maintain flexibility in the mechanisms by which they form or support a particular focus of scientific, academic or professional excellence. In those cases in which a graduate program is not the appropriate avenue for such development, other strategies should be considered. Centers and institutes, which typically have more flexibility than existing academic programs, can play a critical role in the development of new research and service initiatives. By focusing activity in particular areas in a timely manner, they can exploit important opportunities as they develop. Sharing of resources within or across universities is another such strategy—given the expense of new faculty and new equipment—every higher education institution needs to consider. While this is not an easy solution, the faculty associated with such shared focus areas can then flexibly interact across programs or departments, or across several universities in a manner which may maximally leverage resources.

Research centers in the social sciences, humanities, sciences, and professional fields contribute importantly to the quality of graduate education, offering students an opportunity to interact with leading researchers from Rutgers and other universities, providing a forum for interdisciplinary work, and establishing a link between “pure” research programs and practice-oriented programs. While some of these centers require large physical plants and expensive equipment, others can, with relatively modest investment, function as intellectual centers. Indeed, some of these may be “virtual” centers, maintained by electronic links. These centers of excellence are key to attracting and retaining internationally distinguished scholars. But such units can generate significant costs to universities if they are not successful in securing external support. Such units should be evaluated on a regular basis, using a process similar to that used to assess other research, instructional, and service programs, and there should be provisions for closing these units if their mission is no longer being served. Because of their importance to the intellectual life of the community, the best of these units need to be supported by their universities, whether or not they garner significant sources of external funding income.

Faculty should be encouraged to fashion innovative new interdisciplinary specializations that are responsive to cutting-edge research in their own and in allied disciplines. These alliances provide alternatives to expensive proliferation of programs, and focus instead on the substantive areas of common interest among faculty and graduate students. In graduate education a balance must be achieved between the necessary skills of a single discipline and participation in emerging interdisciplinary research foci.

While there are fewer research centers at Rutgers in the social sciences and humanities than in the sciences, they contribute importantly to the quality of graduate education, offering students an opportunity to interact with leading researchers from Rutgers and other universities, and providing a forum for interdisciplinary work. Examples are the Center for the Critical Analysis of Contemporary Culture, the Rutgers Center for Historical Analysis, the Eagleton Institute of Politics, the Center for Women’s Global Leadership, the Center for Global Change and Governance, and the Rutgers Center for Cognitive Science. These centers of excellence, supported by a relatively modest investment of university funding as well as external funds, are key to attracting and retaining internationally distinguished scholars. We recommend that the administration seek to facilitate the academic values that these centers embody.

Faculty Advisory Councils

Faculty Advisory Councils, composed of the best research faculty at the university, can provide critical advice to university officials. These councils can work very closely with top levels of administration to provide information and recommendations on myriad research-related issues, such as communication of the importance of research to the public and to government officials; strategies for increasing the number

of federal fellowships and training grants; recommendations for collaborative, interdisciplinary research that could increase the likelihood of obtaining large blocks of federal funding; and descriptions of recent discoveries and innovations in fast-moving fields of research.

Industrial Advisory Boards

To sustain and improve the quality of our graduate programs, Rutgers' *Strategic Plan* has identified the need to increase graduate student support. This is likely to require new sources of support, and, in the sciences, increased emphasis on training grants (see COSEPUP recommendation) and support from industry.

Nationally, the availability of academic jobs in the sciences and engineering relative to the number of new Ph.D.'s has declined, and there is an associated shift toward nonacademic jobs. For Ph.D.'s produced in 1993, 37% in computer and mathematical science, 46% in life sciences, 68% in physical sciences, and 75% in engineering took jobs outside higher education.⁹ Industry is increasingly interested in graduates with broad, but at the same time in-depth, knowledge and a demonstrated ability to conduct independent research. Growth in graduate education will require a broader educational experience for our graduate students and better relations with industry.

University-wide industry advisory boards, specifically dedicated to maintaining graduate program strength, can put universities in strong positions to leverage funds and provide the necessary leadership to enhance support for students and programs. Rutgers already works closely with industry through its research enterprise, and a number of units and centers have advisory boards with strong industry representation. A university-wide Industry Advisory Board specifically dedicated to maintaining graduate program strength would be in a strong position to leverage funds and could provide the necessary leadership to enhance support for students and programs. This board would consist of individuals who have already shown an interest in graduate education and would have the specific tasks of making recommendations for improving and supporting graduate education. Contributions could be identified for specific units but emphasis would be given to maintaining strength in all graduate programs. The board would also take an interest in up-to-date performance statistics, including the placement of our students over at least a five-year period following graduation. Many corporations currently support Rutgers graduate programs either as a philanthropic activity or through applied-research partnerships. The proposed Board would enhance both relationships. Direct support for graduate education is both a philanthropic activity and an investment with a direct payoff in employment of graduates with appropriate experience and knowledge. A focus on strengthening graduate education will attract increased interest from industry in the quality of research at Rutgers and in the entire mix of educational activities, including undergraduate education. In addition, these industry/university interactions will most likely increase the financial support of research programs at Rutgers.

Novel Funding Mechanisms for New Faculty Positions

Rutgers has made recent, dramatic improvements in the quality of its faculty and graduate programs, as evidenced by its election to the American Association of Universities (AAU) in 1989. In its goal to be ranked within the top quartile of the highly regarded research universities which make up the AAU,

⁹ Hartle, Terry W. and Galloway, Fred J. "Too many Ph.D.s ? Too many M.D.s?" *Change*, September/October 1996, pp. 27-33.

Rutgers must build on its strengths and invest its attention and funds in highly productive and innovative ways. A major goal should be to strengthen our existing faculty by recruiting additional outstanding junior and senior members and by encouraging our junior faculty to become world leaders in their respective fields. Our junior faculty members represent the future of Rutgers; they must be given strong and reliable financial support, and senior faculty members must provide mentorship and advocacy. Rutgers cannot allow our most outstanding junior faculty members to be recruited to other institutions, but must fight strongly to keep them, as they are key to the enhancement of our national and international reputation.

Money raised in Rutgers' upcoming capital campaign should be used to set up endowments to fund short-term assistant professor positions. These positions should be prestigious and enable the university to compete for the highest-quality candidates. Additionally, funds should be set aside from indirect costs associated with external grants and contracts for use in supplementing new faculty startup packages. In recent years, many departments have had extreme difficulty in offering competitive startup packages to their top faculty candidates. Rutgers should not allow this problem to persist; we are losing prime additions to our faculty and are risking our national reputation. The novel funding mechanisms proposed here may help in attracting new faculty on the cutting edge of research.

Retirement Incentives

Recent changes in federal law regarding retirement have brought imbalance to the number of faculty at different levels (assistant, associate, and full professor) at colleges and universities. New laws may profoundly affect research and graduate education. Retirement incentives, in addition to the traditional monetary and health-benefit retirement packages, are needed to encourage older, tenured faculty members to retire so that new junior appointments can be made. While there is no simple correlation of age, energy, and intellectual creativity, an academic enterprise cannot prosper without a constant infusion of new ideas from younger scholars to balance the experience of those with long tenure. Accommodations can be made for retiring faculty in order to maintain their connection to the university and to recognize their contributions. The university should recognize and support contributions that these retired faculty members can still make to the intellectual life of academia and consider their appointment to committees and inclusion in the teaching of courses. Decisions of individuals to stay in academia in their senior years are undoubtedly dependent upon several factors, including economic needs, the desire to continue to be productive, and a sense of responsibility to one's field of expertise. Thoughtful, individualized solutions, in the context of measures to insure that reasonable productivity is maintained, should address each of these issues.

Increased Support for Research

Support of long-term, basic research is an economically sound investment. A case-study of the monoclonal antibody and HIV test markets published by the Federation of American Societies for Experimental Biology in 1993 estimated the total cost/benefit ratio of investment in research at 20:1¹⁰. Additionally, the National Institutes of Health estimates the annual return ratio of NIH support in the areas

¹⁰ Raiten, D.J. and Berman, S. M.: "Can the Impact of Basic Biomedical Research be Measured?: A Case Study Approach." Life Sciences Research Office, Federation of American Societies for Experimental Biology, Bethesda, MD, August 1993.

of diagnosis, screening, and evaluation at 22:1 to 24.6:1¹¹. Universities are the major source of the long-term, basic research that underpins most major discoveries, and the majority of the funding for their basic research programs comes from the federal government (federal dollars fund 60% of the research and development expenditures at U.S. universities and colleges). Federal funding for research at universities is supplemented to a very small extent by funds from industry (7% of total R&D expenditures). Nobel Laureate Leon Lederman, former president of the American Association for the Advancement of Science, noting the great fiscal stresses experienced by universities and their faculty members, proposed a rapid doubling of financial support for universities, followed by more modest increases.¹² Many argue that the investment in university-based basic research should be substantially greater than it now is in order for us to be in a position to make significant progress in solving our nation's many problems and for America to remain competitive educationally with other countries.

A period of slow growth in real R&D support in the U.S. began in 1986 and has continued through the 1990s. Although this protracted trend is expected to continue, there have been some recent positive signals of increased support for research. The challenge for us at this time is to persuade the government and the private sector that an increased investment in basic research would be in their interests, and to encourage innovative partnerships among universities, government, and industry. Comprehensive senior institutions need to consider how such funds will be distributed in the educational landscape. Given a rapidly expanding field of higher education providers, many without the resources to provide high-quality programs, it is critical for those institutions of the highest quality to make the case that resources should follow excellence in graduate education, and to move ahead proactively forging partnerships and alliances to support their programs.

Rutgers is particularly well suited geographically for this challenge; 20% of all national industrial research and development dollars are spent in our state. In addition, partnerships with government and industry will contribute to the university's core threefold mission of teaching, cutting-edge research, and service to the needs of the citizens, government, and industries of New Jersey. Such partnerships will improve communication between the university, government, and private sector within the state and beyond, and help us place our graduates in stimulating employment positions.

As described above, sponsored research has increased dramatically at Rutgers in the last 15 years. In 1982 the university received only \$27 million in funding for sponsored research. In fiscal 1996, Rutgers received over \$148 million in external support for research, 4.6% greater than the \$141.5 million received in fiscal 1995. Federal funding was about \$91 million (61.4% of the total), state support was over \$22 million (15.2%), corporate support totaled almost \$14 million (9.2%), and support from foundations was \$21 million (14.2%). (See Table 12.)

¹¹ "Cost Savings Resulting from NIH Research Support. A Periodic Evaluation of the Cost-Benefits of Biomedical Research." U.S. Department of Health and Human Services, Public Health Services, National Institutes of Health.

¹² Lederman, L. M.: "The Advancement of Science." *Science* 256 (1992), pp. 1119-1124; and Lederman, L. M.: "Science: The End of the Frontier?" A report from Leon M. Lederman, President-Elect to the Board of Directors of the American Association for the Advancement of Science, January 1991.

Rutgers received an average of \$27.3 million per year in corporate support in fiscal 1991–95 in the form of research grants and contracts, grants-in-aid (ORSP), noncontractual gifts (RU Foundation), and licensing income (CLTT). (See Table 13.) Outside of an anomalously high amount of corporate research grant and contract dollars in fiscal 1993, total dollar support has increased steadily in grants and contracts, gifts, and licensing income, while the amount of grants-in-aid has remained steady.

IMPACT OF GRADUATE EDUCATION AND RESEARCH ON SOCIETY

Examples of the positive impact on society of basic research and graduate education accomplished at institutions of higher learning are easy to identify. Without basic research, life expectancies would be much lower than they are now, killer diseases such as polio, smallpox, and pellagra would still be common, and we would have no computers, no global communication networks, and very few of the everyday conveniences we take for granted. Currently, strides are being made against many major health problems (such as AIDS, cancer, Alzheimer's disease, and drug-resistant strains of tuberculosis and other bacterial infections), but substantial investments of additional resources into basic research will be required in order to understand and conquer these diseases. In the current atmosphere hostile to higher education funding, we need to do a better job in showing the public how research and graduate education continue to have critically important effects on society.

Relationships with industry provide one important mechanism for making this important public statement and, at the same time, garnering the resources to be effective. Many ongoing research projects at Rutgers and at other institutions are of interest to potential industry partners. While businesses tend to underinvest in basic research, partnerships enable them to obtain the results of basic research, while simultaneously providing important philanthropy to the university. Some partnership projects, including development of techniques to alleviate language-based learning disabilities, use of neural network principles in the development of detection systems for mechanical equipment flaws, and phytoremediation of radioactive waste, will have immediate impact in the private sector. Other research programs with longer timelines for payoff, such as determination of the three-dimensional structure of AIDS proteins and investigation of the cancer-prevention potential of natural products, are nonetheless quite attractive to industrial partners.

Current Alliances with Industry

Rutgers participates in a wide variety of industrial alliances; a few of these are briefly described below.

Johnson & Johnson

Johnson & Johnson has given Rutgers a tremendous amount of support over the years and has established itself as a full partner in a number of Rutgers initiatives. With a gift of \$2 million during the last Campaign for Rutgers, the Johnson & Johnson–Rutgers Program in Fiber Optics Medical Research was established and the Johnson & Johnson Discovery Research Awards Program was created. Five years after this gift, Johnson & Johnson contributed another \$2 million to Rutgers to continue the Discovery Research Awards Program (which funds promising research initiatives that are of broad relevance to the health sciences and are jointly selected by J & J and Rutgers) and to support the Environmental and Occupational Health Sciences Institute, predoctoral fellowships in biotechnology, the neurosciences, and pharmaceuticals, the Center for Mathematics, Science, and Computer Education, and the Live for Life Nurse Fellowship Program.

Corning

The Corning Foundation made a \$100,000 grant award to fund the Discovery Program at the Institute for Engineered Materials. This award provides funding for stipends for ten high school students participating in the Cook College Discovery summer program, competitive scholarships for minority students who are enrolled in the ceramic engineering or fiber optics program at Rutgers, and support for five faculty members from the Department of Ceramic Engineering who act as summer minority mentors.

Bristol-Myers Squibb

Bristol-Myers Squibb joins Rutgers in the support of the Bristol-Myers Squibb/Rutgers University Pharmaceutical Industry Post-Doctor of Pharmacy Fellowship Program, which fully finances three fellowship positions. During their tenure, the fellows receive training in the Professional Services/Medical Educational/Drug Information Section of the Bristol-Myers Squibb Company.

Bristol-Myers Squibb has also funded “A Partnership: The Bristol-Myers Squibb Minority Research Program,” the goal of which is to increase the number of Latino and African-American students who go on to pursue careers in biomedical research. The partnership has the following three components: (1) the BMS High School Scholars Program, through which students from targeted communities are tutored by Rutgers undergraduate students and mentored by Bristol-Myers Squibb and Rutgers scientists while gaining exposure to laboratory research projects; (2) the BMS Undergraduate Research Intern Program, through which undergraduate students conduct research under the mentorship of Rutgers faculty and Bristol-Myers Squibb scientists; (3) the BMS Minority Graduate Fellows Program, through which students working toward a Ph.D. degree in the biomedical sciences are sponsored and are given research opportunities at BMS in addition to those obtained through their regular program of studies at Rutgers.

A report recently prepared at Rutgers¹³ offers a number of very interesting observations. The report notes that most corporations are currently restricting their external support and philanthropic gifts to programs which are closely aligned with their business objectives. Often, a company pools its philanthropic and marketing dollars to support “cause-related marketing.” Higher education institutions should view this new paradigm as an opportunity to establish a coherent industrial relations program and to look for ways in which mutually beneficial partnerships can be established with industry and government.

It is important to note, however, that in the foreseeable future, the main source of funds for research and development activities at universities will continue to be the federal government, and Rutgers should focus significant efforts on helping its faculty members compete for these funds. Interactions with the private sector should complement efforts to obtain federal grant support and should not divert those efforts. With this in mind, partnerships with the corporate community should be fostered to increase current levels of industrial support for undergraduate and graduate programs, research, and development at the university. Industrial advisory boards for graduate education, as discussed above, can be helpful in enhancing relationships with the private sector

¹³ “Report on Corporate Support of Rutgers,” prepared by Rutgers University Foundation, the Office of Research and Sponsored Programs, and the Office of Corporate Liaison and Technology Transfer, November 1996.

It is critical that Rutgers maintain easily accessible databases on past, current, and planned involvement with specific corporations (research collaborations, technology transfer agreements, grants, contracts, and gifts), recruitment of students to corporations, and continuing education arrangements which have been established. In addition, up-to-date information on companies and ongoing research projects at Rutgers should be available and accessible in database format. Knowledge of such details will allow Rutgers to “speak with one voice” in building relationships with industry and will help in determining needs which can be addressed. As a caveat, coordination of Rutgers’ communication with the private sector should not inhibit faculty members from approaching personal contacts at specific companies, provided faculty members inform the proper channels at Rutgers of their intent.

Preparation for Diverse Career Options

There is an increasing trend among recent Ph.D. graduates, especially those in science and engineering, to find employment in the private sector rather than in academia. For instance, the percentage of science and engineering Ph.D.’s employed in business and industry five to eight years after receiving their degrees had increased from 26% in 1973 to 45% by 1991. Reductions in the number of basic research and academic positions has led to a “frustration of expectations among new Ph.D.’s.”¹⁴

It is therefore becoming more important to inform graduate students of the diverse career options open to them upon graduation. A number of changes can be implemented to accomplish this, and student morale will be heightened in the process. The New Brunswick graduate programs in physics and astronomy and in chemistry have made strides in this direction. Among the steps that have been taken are these: Lists of Ph.D. graduates are maintained and their current positions are catalogued, placement committees have been established to provide general advice on career services, and annual information sessions on preparation for diverse career options are held. An innovative initiative between the Chemistry Department–New Brunswick and Hoffman-La Roche (HLR) Corporation is designed both to aid recruitment of American graduate students and to acquaint aspiring chemists with career options in the pharmaceutical industry. Starting this year HLR is covering the travel expenses of all American applicants whom the Chemistry Program is interested in recruiting. Invited applicants will spend a morning at HLR, where they will be introduced both to the company and to the Rutgers graduates employed there, before coming to the campus to speak with faculty and graduate students. In addition, the graduate program in physics and astronomy is becoming more proactive in placing graduate students in industrial internships and is enhancing networking opportunities between the faculty and industrial physicists to increase the number of internships available to their students.

Fulfilling Private-Sector Needs

While the current system of graduate education in the U.S. furnishes students with a deep grasp of fundamentals, and trains candidates in problem-solving skills, several recent publications, including the National Academy of Sciences report, identify additional capabilities the private sector desires from master’s and Ph.D. program graduates, including: heightened communication skills (including proficiency in communicating complex ideas to nonspecialists), ability to work in interdisciplinary teams, and ability to adapt readily to change.

¹⁴ *Reshaping the Graduate Education of Scientists and Engineers*. Washington, DC: National Academy of Sciences, 1995.

In this age of global competition and information flow, we cannot isolate ourselves and assume that the future definition of learning or of universities will resemble the present. While we have an opportunity for reevaluation of the process of graduate education and its relation to the private sector, universities need to take a long-term view of the labor needs of different industry sectors. The costs and time involved in making profound changes or in implementing new degree programs force universities to disregard fashion and analyze whether such a need will exist for a long period of time. While it is important to consider whether our product is of value to the marketplace now, we cannot risk corruption of the basic mission of the university.

Minority and Diversity Issues

The benefits of a diverse student body are well understood, but considerable inequities remain. AAU institutions need to push for continued progress toward greater representation of minorities on their faculties and in their student populations. Affirmative action programs are under attack nationwide, and the next few years will be crucial ones, politically and in the courts. Universities must be active as the debate unfolds; arts and sciences, law, management and education all have roles to play in ensuring that the values of diversity are understood. And, if necessary, creative new ways must be found to continue the diversification that has already begun.

The national shortage of minority students in the sciences has been well publicized, but the statistics for the arts and humanities as documented by the National Academy of Science's *Summary Report 1993: Doctorate Recipients from United States Universities*, are just as unbalanced. According to this study, in 1993 African-Americans received five of a total of 269 doctorates in American history, 18 out of 948 in English and American literature, 20 out of 906 in economics, and 6 out of 274 in philosophy. Under these circumstances, it is important that in addition to vigorous recruitment and retention of a still-limited pool of students, efforts should be made to increase the pool itself. Summer institutes, mentoring programs, special recruitment efforts, and appropriate academic and social support groups can all play positive roles in recruiting a diverse student body and in helping students succeed in graduate education. Universities must nevertheless recognize that special higher education programs designed to attract students who have been educationally disadvantaged can only provide a very limited solution to the much larger problem of inadequacies in educational programs at the precollege level. The New Brunswick graduate program in philosophy is doing just this, in cosponsoring with the American Philosophical Association summer institutes for minority undergraduates considering an academic future.

Rutgers is committed to recruiting a diverse graduate student population, and to creating a productive and hospitable environment for them once they are at the university. It is therefore welcome news that the African-American student population has doubled since 1991. Thus while Rutgers ranked 30th among the top 50 U.S. institutions (including both historically black colleges and universities and traditionally white institutions) in 1991–92 in the total number of degrees conferred on minority students, it ranked 26th in the number of doctoral degrees conferred on African-Americans in 1992–93, 17th in the number of doctoral degrees conferred on Hispanic Americans, 33rd in doctoral degrees conferred on Asian Americans, and 24th in degrees conferred on all minority groups.¹⁵

To locate gifted minority undergraduates who might be interested in graduate school, several graduate directors report that they use the ETS GRE Minority Locator Service, while the Graduate School–New

¹⁵ “Black Issues in Higher Education. Top Degree Producers’ Fifth Annual Special Report,” May 30, 1996.

Brunswick has worked with the National Consortium for Educational Access (NCEA). In addition, some programs solicit minority applications directly from leading undergraduate programs, or from historically black colleges (as the graduate director for Spanish–New Brunswick, for example, did with site visits to some of these colleges this year). The Minority Advancement Program (MAP) run by the Graduate School has been dedicated to providing financial and academic support to students once they are on campus, with the aim of increasing the number of minority students who complete doctoral degrees at Rutgers. The activities of the program cover a wide range of academic, recruitment, admissions, financial aid, and retention efforts focused on minority graduate students in all of Rutgers' graduate and professional programs.

To recruit able minority students and retain them, financial support is crucial. In 1994–95, 19 MAP, five MAC, and three Minority Trustee Fellowships were awarded by the university. Additionally, minority candidates have competed successfully for Excellence, Mellon, and Bevier (dissertation) fellowships that are available to all students, as well as for Ford and NSF minority student fellowships, the federally-funded Patricia Roberts Harris Fellowships for Underrepresented Minorities, and the Minority Biomedical Research Support Program, which supports undergraduates and graduates on the Newark campus.

In 1996–97, the graduate programs in history and English in New Brunswick were notably successful in recruiting minority students: history admitted five (in an entering class of 19) and English seven (in an entering class of 28). Thus English now has a cohort of 36 such students, principally African-American, giving it one of the largest concentrations of African-American graduate students of any major research university in the country. Other programs have been equally aggressive in competing for gifted minority students. Psychology–New Brunswick's entering class of 25 for 1995–96, to take another example, included six minority students with GRE averages considerably higher than the norm for several of our programs (635 verbal, 660 quantitative).

Rutgers' efforts to recruit minority faculty have been supported institutionally with strategic planning and multicultural program funds set aside especially for this purpose. Recruitment has been very successful this year. For example, in arts and sciences in New Brunswick, very competitive national searches have yielded six African-American and two Hispanic faculty of the highest caliber (in the fields of history, English, Spanish and Portuguese, and women's studies).

Linking Graduate Education and Research

Research and graduate education could make an even greater positive impact on society if communications among universities and local citizenry, state and national governments, and industry were improved. Links between academic programs at the university and research/service programs in the larger community enhance the educational opportunities of students at the university and provide a range of opportunities to develop and carry out research while providing critical community services. In relation to the public university's overall mission of providing public service as well as teaching and scholarship, the professional schools provide an excellent model. Service flows readily from the teaching and research missions, because the professional schools' focus on applications of knowledge means that students can be taught and new knowledge gained in the course of serving the public. In this way time spent in service to the public does not compete with other educational goals. This is also true of many professional programs in the visual and performing arts, where the performance itself can be a teaching vehicle, an exploration of new ideas, and an extremely pleasing experience for the viewing public.

Service programs in the arts and sciences can also develop innovative alliances linking research and service. For example, the Waksman Challenge Program at Rutgers links faculty and graduate students at the university with high school students and their teachers all over the world, in ongoing research and instruction in bioinformatics. The Waksman Challenge is building a virtual research community by establishing working relationships between research scientists at the Waksman Institute of Microbiology and teams of high school students and teachers. Each month during the academic year, a group of faculty from the Waksman Institute devises a research problem of moderate complexity on the topic of bioinformatics, genomics, or computational biology (new fields that combine molecular biology and aspects of computer science) and posts the question on the program's home page (<http://morgan.rutgers.edu>). Students from participating high schools working in groups attempt to answer the question using databases and software resources of the Internet, as well as other resources they can bring to bear on the subject.

The Waksman Student Scholars Program is also designed for high school students and their teachers. Research teams consisting of two or three students and one teacher from participating schools are selected to take part in a four-week summer program held at the Waksman Institute. Participants learn about current science as well as experimental design, research methods, laboratory procedures, data collection and analysis, and scientific reporting and presentation of findings. Throughout the ensuing academic year, the students apply the skills and knowledge they gained during the summer program to investigate a contemporary, original research question at their own schools.

Rutgers plans to recognize the substantive work of students in the above programs by awarding college credits to active participants. Students wishing to receive college credit will be billed for tuition fees, and these revenues will be used to support the programs.

The Waksman Challenge and the Waksman Student Scholars Program have been supported by the National Science Foundation, Bell Atlantic, Schering-Plough, and Merck. Merck was an early partner in the development of these programs, but withdrew support after a few years, and instead set up its own elementary and middle school outreach program (funded at the rate of more than \$1 million per year). It is possible that this disturbing loss of a corporate partner could have been prevented if a high-level industrial advisory board at Rutgers had been in place, was aware of the Waksman programs, and communicated their importance to upper management at Merck.

Major research universities have a unique role to play in the collaborative process of developing and implementing these sorts of programs. Community colleges and small colleges do not have the resources necessary to provide the research component of such endeavors. Universities need to support these initiatives, with the assistance of industrial advisory boards, matching funds, and institutional support for collaborative, multidisciplinary research programs.

Discussion

Graduate and professional programs play very important roles as “keepers of the flame,” maintaining and nurturing the basis of higher levels of human knowledge. The inevitable ebb and flow of the economy may affect the number of students seeking any given graduate degree, as the ebb and flow of culture and politics may place historians in demand over rocket scientists at different points in time. Graduate and professional programs must be alert to the emergence of new disciplines and the fading of others, but in neither case should core values be held hostage to short-term fluctuations. Universities across the nation must keep the consciences of the specialized graduate training and professions, while they seek to keep the

spirit of classical learning alive. While the definition of an educated person has changed, the concept of educating rather than simply training our students has crucial practical implications: it results in the type of educated person who can remain flexible and useful long after the utility of narrow training wanes.

Given the set of circumstances facing doctoral education, the future direction of policy making should be shaped by two forces. The first must come from internal reform initiatives within the academy, coupled with innovation and further refinement of what doctoral education should become. The second force for change must be driven by selected public investment in programs of quality. Given severely constrained resources, it is imperative that states not make decisions regarding institutional support based solely on cost and enrollment data. Not all institutions can afford to offer high-quality doctoral programs; schools with insufficient resources (in faculty, in students, in physical plant, in research initiatives) should not offer these programs. In the coming years, AAU institutions need to provide a strong, clear voice for public and private support of excellence in graduate education.

CENTERS, BUREAUS, AND INSTITUTES

There are over 100 recognized centers, bureaus, and institutes (CBIs) at Rutgers. (Appendix 1 lists them.) We elected to interview the directors of a small subset of CBIs chosen to represent some of the principal examples of CBI structure and organization. In order to obtain a balanced view, we also met with department chairs and others who interact with the CBIs that we selected. (The CBIs we looked at and the other persons we talked with are listed in Appendix 2.) A standard set of questions was used for these interviews and the answers we obtained were used to compile this report. Our comments are meant to apply to nearly all CBIs at Rutgers. Although we have mostly used science CBIs as examples, there are many others in diverse disciplines that could have served equally well had we the time to review them.

IMPACT OF THE DEVELOPMENT OF CBIS

CBIs present an important opportunity to promote multidisciplinary and interdisciplinary research by providing a venue that enhances the likelihood that strong faculty from different disciplines will work together on common problems. Their efforts enrich the scientific community and enhance Rutgers' visibility. It is important to recognize that CBIs serve as mechanisms to strengthen scientific or academic excellence in specialized areas, when such a focus would not be appropriate for a traditional department. The CBI can develop in areas that are both interdisciplinary and yet too specialized for a free-standing department, as, for example, in neuroscience.

CBIs have significantly enhanced Rutgers' ability to recruit very able faculty with new skills and new programs. The centers, in turn, have attracted grant money, undergraduates, graduate students, postdoctoral associates and visitors. The visibility of the faculty as a whole has risen significantly, and some of the best young people in a number of disciplines have trained at Rutgers over the past decade. In several cases CBIs have matched almost exactly the recent interest of some national agencies in fostering multidisciplinary research. The CBIs have added to the richness of the university's resources and have made it far more responsive to community needs. The publications, patents, technologies, royalties, public service and outreach, and enhanced reputation resulting from their establishment have added to the university's stature and visibility both nationally and internationally.

CBIs arise to exploit opportunities in research, instruction or service. Their genesis is often a response to a target of opportunity created by forces external to the university, such as needs of the State of New Jersey. Historically, they developed due to specific local academic strengths, or the ambition of faculty and administrators, usually with the critical addition of a particular leader to crystallize and expand these strengths. For example, the Center for Molecular and Behavioral Neuroscience (CMBN) was established with strong faculty already in place, with specialized knowledge in neuroscience and closely allied fields, in order to help the university focus its strengths in this area. With this goal, local leadership sought both internal and external funding to support the development of the CMBN. The Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) similarly originated with an NSF Science and Technology Award to strong, existing academic programs in mathematics and computational sciences, whereas the Waksman Institute built upon nationally recognized research strengths already in place in biophysical chemistry and structural biology. In contrast, the Center for Advanced Biotechnology and Medicine (CABM) and the Center for Agricultural Molecular Biology (AgBiotech) were developed with new hires.

In the 1980s the formation of the New Jersey Commission on Science and Technology (NJ CST), with funding to establish Advanced Technology Centers (ATCs), enabled the university to identify and finance science areas with resources available only for this purpose. CABM and AgBiotech provided opportunities to recruit faculty with skills and interests to complement those already in place at Rutgers and UMDNJ. The Center for Advanced Food Technology (CAFT) was established to encourage food science to make more effective use of the skills and experience of faculty in some 12 other university departments. The Fiber Optics Materials Research Program (FOMRP) brought together faculty in 14 departments. The Institute for Marine and Coastal Sciences (IMCS), the Environmental and Occupational Health Sciences Institute (EOHSI), and CMBN developed to take advantage of the nationally recognized need for academic growth in these areas, and also brought together faculty from many different units.

CBIs have provided recruitment incentives, without which many high-caliber faculty would not have joined the university. Some, mostly small centers, helped us retain individual faculty by giving them greater visibility and independence. Others, mostly soft-walled, were set up by faculty who wished to join together to establish a CBI to further their research or, as in the case of the Center for Molecular Biophysics and Biophysical Chemistry, to provide a common intellectual home for researchers in the same field scattered in different academic units and centers. Some are very small in terms of academic appointments associated with them, like the Center for Global Change and Governance (CGCG), but were established to focus the interests of faculty in a range of different areas, such as international policy and economic development. Other small centers have even more focused agendas: for example, two centers run by management faculty, the NJ Center for Financial Services and the Center for Entrepreneurial Management, pull together a pool of faculty largely from their own school. With small amounts of external funding these centers serve as multidimensional resources that promote faculty interests and visibility.

Faculty of all CBIs must be tenured, or occupy tenure-track lines, in academic departments. This arrangement has a wide variety of permutations. Some CBIs are constituted from faculty of several different departments. Others, like IMCS and CMBN, have members who hold their academic appointment in a department of the same name. Many, but not all, of the larger hard-walled CBIs have resident faculty (CAFT has no resident faculty; DIMACS has far more nonresident than resident members). In most large hard-walled CBIs, only residents participate fully in access to shared services, and attend regular CBI faculty meetings. However, EOHSI has resident full members and many nonresident

full members with the same privileges as resident members. Some CBIs (CABM, AgBiotech, FOMRP) do not have nonresident members. Others extend membership to nonresident collaborators. Membership can take various forms, such as: involvement in seminar programs, invitations to periodic meetings, special rates for using services or equipment, and, in the case of the Waksman Institute and DIMACS, eligibility for the same financial resources as full members. CABM has set up shared service units and has provided equipment funds that benefit faculty in several departments.

Some CBIs are very small, but serve as important foci for research issues. For example, the Institute of Biostatistics (IOB) in New Brunswick fosters collaboration between Rutgers' researchers and New Jersey pharmaceutical companies; the CGCG in Newark focuses on interactions with the international business and political community in the tristate area, and provides a critical base for research and instruction in international issues.

In an effort to rationalize our system and provide better oversight, the CBIs in New Brunswick were reorganized this year so that the majority are now under the aegis of related decanal units. This restructuring should allow better integration between CBIs and academic departments. The New Brunswick CBIs that are not in existing decanal units now report to the university vice president for academic affairs. The plan is to enhance accountability through regular meetings, coordinated planning efforts, and a closer relationship between resource allocations and evidence of effectiveness. It is still too early to assess the effects of these structural changes. CBIs located on the Newark and Camden campuses largely report to their respective provosts.

RELATIONSHIPS BETWEEN CBIS AND ACADEMIC DEPARTMENTS

Among the CBIs we examined, the relationships with the departments they are closest to were for the most part rewarding for both parties. However, for CBIs to be really successful, benefits must flow in both directions so that new partnerships and new initiatives can develop. There is a view that CBIs are less parochial and inherently more flexible than departments. If this is true then an important role that CBIs should play is to help departments to be more open to new ideas. Some department chairs seek to conserve the status quo rather than seek collaboration to move in new directions. Other department chairs complain that some center directors resist interactions of potentially mutual benefit. Unfortunately some departments feel threatened by CBIs and are jealous of new facilities and generous startup grants, forgetting that many of the larger CBIs have had to begin from nothing, and that the initial external funding could not have been used to improve departments. Problems can arise when the influx of funds to center hires greatly exceeds that available for equivalent faculty hires in other academic units. DIMACS and EOHSI have avoided such problems, the former by allocating its funding to the participating departments, and the latter by returning to departments their fraction of indirect cost recovery (ICR) dollars.

The two principal foci for interaction for those CBIs with resident faculty are the search committees to fill CBI/department tenure-track lines, and the departmental reviews of reappointment or promotion packages. The latter are a cause for concern; if there is no encouragement for center faculty to participate in department affairs, the decisions made by department faculty are not well informed. For those CBIs with nonresident members, the need for junior faculty to play a major role in their home departments can limit their contribution to the CBI. By contrast, common housing in the same building has fostered interactions between centers and selected departments (e.g., CABM and DIMACS). There is a serious concern that the department now is the primary initiator of tenure and promotion decisions independent of the line

distribution of the appointment. If the primary line weight is in the CBI, the individual should primarily be evaluated by the CBI.

When the larger CBIs with resident faculty were first established, there was concern among department faculty that the center faculty would not share the teaching burdens. In our admittedly small sampling, we found no evidence that this is a continuing concern. There are still remnants of jealousy, largely unfounded, on both sides: center members feel that they are teaching without recognition from the departments; department members feel that center faculty do not contribute their fair share to the academic program. A chair of a large department noted that the reduced teaching load accorded center members in his department helped them to maintain highly active research programs. Some faculty resent differential resource distributions between CBIs and departments, and believe that CBIs have better support and facilities through their soft money successes than the departments have.

Ideally, the relationship between departments and CBIs should be one of mutual benefit and funding should flow in both directions. The centers and departments with best interactions to date are housed in the same building, include nonresident faculty who benefit from shared funds and resources, and/or focus on common intellectual problems. Center faculty members who bring their research expertise to the classroom typically attract outstanding students to work in their laboratories. For CBIs with resident members the requirement that tenured or tenure-track faculty have departmental homes provides the opportunity to develop strong relationships, but does not ensure that they will occur. CBIs with few or no resident members are inherently dependent on academic departments and cannot develop unless these relationships are nurtured. Mechanisms to promote these relationships and build goodwill include sharing overhead returns and royalty income from patents, joint committees, joint membership in graduate programs, assisting in undergraduate teaching and curriculum development, collaborative research proposals, and sharing space and equipment.

CBIs are the university units most sensitive to management and direction since they will quickly founder in the absence of external funding support. In CBIs, individual principal investigators have considerable freedom to determine research directions. Through close consultation with their directors and with input from industrial and scientific advisory boards, and, at less frequent intervals, from external peer review groups, the thrust of CBI research activity can be guided. The director can also encourage groups of faculty members to undertake projects of interest to the CBI as a whole. A departmental chairman pointed out that one way to foster such initiatives is to increase the indirect cost return to meritorious academic units (e.g., both CBIs and departments) so that they can build upon their strengths.

CURRENT RELATIONSHIP BETWEEN RESEARCH AND PUBLIC SERVICE

In our experience, there are few faculty members who would deny themselves the opportunity of seeing their work used for the public good. In addition to the kudos, there is a sense of satisfaction in having done something important and worthwhile for society. We believe these feelings motivate much of what CBIs do that is related to public service. Some of the ways in which various CBIs have effected these programs are described in earlier sections. One director pointed out that the connection could be indirect, with deferred/long-range benefits rather than immediate outcomes. Universities need to maintain their focus on basic research with long-range outcomes rather than attempt to redirect the research effort toward short-range outcomes for the sake of demonstrating public service connections. The basic research function of the university should not be eroded for the demands of the moment.

Most of the science-based CBIs strive to carry out fundamental research in areas which have a practical and, therefore, public-service significance. While some of their work is directed toward enhancing the application of science, much of it is concerned with understanding basic phenomena. CBIs are aided in maintaining this balance by expert Advisory Boards.

The diversity of the CBIs is once again reflected in the diversity of specific examples of applied types of public service. In Newark, the CMBN carries out research programs that focus basic work on the most common diseases of the human brain, and range from dyslexic children to linguistic needs of indigent populations in Central America. Several New Brunswick centers, such as the Center for Biomaterials and the Center for Ceramic Research, work closely with industrial partners to solve technical problems of common interest. The Eagleton Institute has achieved state, national and international visibility for its work on public opinion polling, gender and politics, and its study of state legislatures.

In addition to intellectual developments of fundamental importance to society, DIMACS faculty members have worked hand-in-hand with the Center for Mathematics, Science and Computer Education (CMSCE) to develop a number of outreach projects, including the development of a K–12 program for teaching mathematics, development of the New Jersey mathematics curriculum, and several summer programs (for young scholars, high school teachers, undergraduates, and college faculty members). The Waksman Institute has also developed a summer outreach program and a program during the academic year for high school biology students and teachers.

The ATCs were expected to have a strong public service role primarily through the transfer of technology to industry and the provision of hands-on training in the basic sciences that underpin the ATCs' research. For some ATCs the university's office of corporate liaison and technology transfer (OCLTT) has been more of an impediment than a help in this process, mostly because of the inherent difficulties in three-way negotiations among university scientists, industry, and OCLTT. CBIs are generally quick to respond to new opportunities for public service; many examples are documented in CBI accountability reports.

ISSUES AND RECOMMENDATIONS

The Ideal Balance in Graduate Education between Research and Teacher Training

CBIs are primarily concerned with research training. Most resident CBI faculty are responsible for one or more graduate-level courses and some have served, or serve now, as graduate program directors. CBIs have no TA positions since these are only assigned to departments. However, grant support to CBIs is an important source of GAs, although the resources are rarely sufficient to enable GAs to rotate among several major professors during their first year. The opportunity to work as a TA is especially important in fields like mathematics, where most students eventually take faculty positions. While all graduate students benefit from an experience like a TAship, which teaches communication skills, improvement of those skills should not be limited to the TA setting.

The Ideal Balance Between Broad-Based Education and Narrowly Focused Research

The ATCs are largely concerned with focused research. However, the resident ATC faculty in our sample participate in teaching undergraduates and graduates indicating their interest in and concern for broad-based education. Our programs should enable our graduates and trainees, wherever they end up, to become leaders in their disciplines at a national and international level. An important feature of having collections of faculty focused in particular scientific or academic areas is that they can work to expose

undergraduates, even first-year students, to the very edges of what is currently understood about a particular topic. This can occur in both the classroom and the research laboratory. A particular subset of the undergraduate population is likely to benefit most from this type of opportunity. Those students with interests and strengths in a variety of scientific areas can gain an unusual level of either broad-based exposure or in-depth training provided by the opportunities that the faculty associated with the CBIs provide.

Another important role for CBIs in undergraduate education is to provide expert depth and breadth to complement that provided by the closely related academic departments. For example in Newark the articulation of CMBN with undergraduate training in psychology, chemistry and biology provides an area of overlap and extension that can strengthen the training environment. Significantly, the genesis of the Center of Molecular Biophysics and Biophysical Chemistry was due to the successful implementation of a campus-wide NIH graduate training program and the cooperative development with the chemistry and MBB departments of a Howard Hughes Medical Institute grant for a novel undergraduate research training experience.

The Ideal Balance between Internships in Industry and Work in a University Setting

Internships in industry teach more than teamwork because they provide an opportunity to test skills and ideas in the real world outside the university. They also teach students what working in a field is really like and help them consider whether they want to devote their professional lives to it. The CBI directors we consulted believed that their students were receiving a graduate education that far exceeded the needs required for vocational training and employment. Several did agree that internships, especially for undergraduates, could open doors for jobs. We believe there is no ideal balance that can be defined for all CBIs. Some CBIs that have not pursued internships in industry might be encouraged to consider whether they could serve their students better with such programs. Industrial internships are mandated by some NIH graduate training programs (e.g. the biotechnology program administered by CABM and the Department of Chemical and Biochemical Engineering). The participation of students in joint university/ industrial teams is a cornerstone of the training program of the Center for Biomaterials, recently funded by the Whittaker Foundation. Rutgers students who have participated in such internships have generally had positive experiences, and the training programs have benefited from financial support from the participating industries.

The Appropriate Role of Research in Undergraduate Education

The CBI directors and others we spoke to believe research plays a very important role in undergraduate education and that it is their responsibility to provide opportunities for undergraduates. As one CBI director put it, “you can’t expect to learn to drive a car by reading a manual.” A department chairman pointed out that an undergraduate research experience provides a different way to look at a discipline from the information conveyed in the classroom or teaching laboratory. In some cases, practical laboratory work can make up for a weak academic record and serve as a stepping stone to professional school or permanent employment. CBIs can play important roles in providing research opportunities directly for some students through internships, honors courses, and limited employment, and indirectly, through enhancing research opportunities within existing coursework.

Criteria for Evaluating CBIs

Centers that have research as their principal focus should be held to high standards for continued leading-edge research. The important means of measuring progress are the standard ones: external funding, faculty research productivity as measured by publications, and performances; faculty teaching as measured

by quantity and quality of students and subjects; and faculty service to the university. Other measures are the success of university graduates associated with the CBI, jobs generated in the state through CBI activities (in the case of the high technology centers), internal and external collaborations seeded by the unit, improvements in graduate and undergraduate education from joint cooperation of CBI faculty, public service and outreach of the CBI, peer review funding awarded to the unit as a whole—in other words, factors that determine whether the net activity of the CBI is greater than the sum of its parts. These are the tangibles that need to be considered. However, it can be argued that the mission of the CBIs is the development of units with national and international reputations, as judged by peers in their areas of specialization. Thus we can consider that our CBIs must also have a more intangible benefit to the university by serving as a focus of expertise in a particular area, and by becoming national and global reference points. Some of the measures of success are the source of external support (peer reviewed funding being perceived as a measure of greatest success), the quality and impact factor of faculty publications, and the entrepreneurial skills of the faculty as a whole (e.g., does technology transfer lead to financial gain for the community?). The ultimate expectation is for the CBIs to achieve visibility and accomplish tasks which individual faculty members or academic departments cannot do alone.

An important question is: “Would the resources that the university has invested in a CBI have had a greater impact had they been placed in academic departments?” This question applies only to CBIs which depend on a substantial commitment by the university, but is difficult to answer in the absence of funding to the associated departments. In our sample, CBI directors and others thought that the university investment was more than justified in terms of increased external grant and industry support. Some centers (e.g., DIMACS) are now bringing in peer-reviewed external funding far in excess of the initial financial investment of the university and the state. However, it remains to be seen how long CBIs can continue to be largely self-sufficient.

We believe that the guidelines for preparing self-study documents, which are directed primarily toward academic departments, need some amendment and adjustment for CBIs. Information that illustrates the health of the relationship between a CBI and the departments it works with should be requested. For example, are there joint committees that deal with subjects of common interest to both parties? To what extent are resources shared—in both directions? What provisions are there for jointly planning policy and the development of new ideas? For CBIs with resident faculty, how many research projects and grant proposals also involve members of academic departments who are not members of the CBI, and how do the nonresident members of CBIs contribute to the mission of the department? How do departments and CBIs pool their resources, for example for support for GAs and TAs? How well do curriculum coordinators work with CBI faculty?

Whether CBIs are large or small, the standard process of academic review that is conducted by the Committee on Standards and Priorities for Academic Development is in general quite appropriate. The specific nature of the charge to the department and to the external review committee must be tailored to dissect the articulation of funding and functions of CBI members with respect to their departments of academic appointment. Much time could be wasted attempting to make uniform on a university level the complexities of CBI membership, funding and productivity reporting. Faculty should be evaluated in ways that recognize their interdisciplinary involvements, rather than in ways that focus exclusively on discipline-based work.

Conditions for Establishing or Disbanding CBIs

The reason to establish a CBI is to provide a jump start into a particular field or to serve a need that requires collaborations beyond the established boundaries of departments and institutions. The CBI structure can provide instant prestige that is important for attracting external funding and further recognition. CBIs could be a mechanism for testing the feasibility of establishing new academic departments. IMCS was, in fact, set up together with a department at the same time. CAFT could be regarded as an extension of the food science department, and FOMRP an extension of ceramics engineering.

There is, of course, no *a priori* reason for continuing a CBI indefinitely. When a CBI is judged to be no longer fulfilling its mission, should it be disbanded? Reasons for disbanding a CBI include: the unit is no longer performing a useful function; the field of common inquiry is obsolete; the technical problem of common concern is solved; the CBI is redundant in comparison with another more successful unit; university priorities have changed; or the CBI is no longer successful in obtaining adequate external funding. The flexibility in CBIs may make them easier to remold or disband than departments. However, the human problems of doing this are no different than they are for departments. Should the CBI become part of an existing academic department, or a new one, or should it be disbanded and its tenured staff revert to their home departments? This last provision, inherent in tenure, was of some concern to department chairs at the time the AgBiotech Center was established. For this reason, when faculty were hired, a tenure home was identified and that department was strongly represented in the search committee. A supplementary question arose: if a faculty member with tenure ceased to be a productive member of the center and was asked to leave, would the department have to accept him or her? The answer was “yes,” but in practice this has not, to our knowledge, yet happened in any of the CBIs where it is a possibility. Some CBI directors in our sample expressed interest in a posttenure review process that could lead to reassignment of research inactive members to their academic departments. Dealing with the issues associated with reallocation of space and increased involvement with teaching will be difficult for all concerned parties. Few CBIs have been disbanded in recent years.

As academic specialties evolve, the utility of a particular center may be expected to change also. The university needs to be concerned with using well and fully the resources it has already invested. Determining an appropriate time frame for a CBI to meet its national and international goals is difficult, and can only be done through focused inspection by experts in the content area in question. However, given that some existing CBIs no longer meet criteria of productivity, or continued performance of leading-edge research as described above, in the context of appropriate review and recommendation by CSPAD, the university should be flexible enough to disband the Center in a timely and efficient manner. The lack of a center in a particular area of focus does not mean that a given productive faculty member cannot continue to do excellent research in the department of academic appointment. Using university resources to shore up CBIs that do not meet high standards means that those resources cannot be directed to fostering excellence in other areas, whether in CBIs or departments.

Appropriate Outcome Measures to Assess Research**Is There a Mix of Qualitative and Quantitative Outcomes to Gauge Progress?**

We are used to making assessments of quality when we consider faculty for tenure. In principle, we see no difficulty in assembling the data for a group of individuals much as is done in self-study documents. Quality of individual faculty is indicated by invitations to serve on committees and to give national and international lectures, by receipt of awards, and by success in obtaining grant support. Although not often

used to assess research, the contributions of CBI faculty to classroom teaching are also important and need to be measured. The assessment of the group, however, should seek evidence of contributions beyond those of the individual faculty (e.g., joint training or research programs, partnerships with industry, financial successes, etc.). The success of research students mentored by CBI faculty members is another important measure of the national and international impact of the unit.

How Should Progress Be Monitored and Reported?

Some centers (e.g., Waksman Institute) are able to publish attractive annual reports. Others (e.g., those that have been supported by NJCST or federal programs) produce annual reports whose form is dictated by the body requesting the report. In practice, annual reports tend to vary in substance and content just as self-study documents do. Most annual reports address the assessment criteria discussed above: publications, invitations, discovery disclosures, patents awarded, grants received, M.S. and Ph.D. degrees granted, etc. Future reports should also address the added value of the CBI as a whole. It would be helpful if the centers created and maintained up-to-date Web pages to publicize their activities and to keep university administrators abreast of their activities on an *ad hoc* basis. It would help CBIs for the university to list the items used to measure CBI progress when requesting reports. CBIs can then make sure that they include data that is useful to the university community, in addition to the data required by the agency requesting the report.

While it may seem that CBI annual reports are prepared mainly for administrators and external review teams, they are useful management tools for CBI directors and their staffs in guiding development and operations. They have value in inculcating a sense of responsibility in those who prepare the reports through the review of past progress and updating of plans. Reports are also useful to confirm or deny impressions that a CBI has a problem. Responsible administrators would expect to use successive annual reports to see evidence of problems, and to evaluate whether appropriate action is being taken. We are hopeful that the realignment of most CBIs with academic departments under decanal authority will help in this process. We also hope that those CBIs now reporting to the vice president for academic affairs will similarly be assessed regularly and provided with appropriate administrative feedback to improve their operations.

THE PROFESSIONAL SCHOOLS

The focus of this self-study report is on the role of the professional schools at Rutgers University, in preparation for the university's reaccreditation inspection in 1998. Initially, we limit our consideration to professional programs at the graduate level; we then consider briefly the relationship between graduate and undergraduate professional programs, and restate some of the themes that we think have national applicability.

DESCRIPTION OF PROGRAMS

Preliminary Matters of Definition

Our charge differentiates between professional programs and those in the arts and sciences, yet neither the charge itself nor any other university document we have been able to discover defines the distinction clearly. At one level, the distinction is intuitive and simple: "professional" programs are concerned with training for a career, while those in the arts and sciences colleges are concerned with "abstract" knowledge.

Students in professional programs “apply” knowledge, while those in the arts and science “create” knowledge.

Intuition can be wrong, however, and simplicity is not always a virtue. Any classification which differentiates professional programs from those in the arts and sciences may be convenient for purposes of discussion, but must be approached cautiously, lest the differences in emphases harden into a gap that is difficult to bridge—for the more accurate view is that graduate programs in any major university are arrayed along a continuum in which both creation of knowledge (the presumptive domain of arts and sciences) and preparation for gainful employment (the presumptive domain of the professional schools) are to be found, albeit in different balances at different points along the continuum.

Thus, a rigorous doctoral program in one of the experimental sciences will inevitably send some of its graduates into industrial laboratories where the expectation is that discoveries must “pay” for themselves, and some lawyers and business managers, through the creative pursuit of their clients’ interests, will in effect “discover” new theories of human organization and behavior. And, of course, becoming a university teacher and scholar is a profession in its own right.

Because of the continuum along which graduate programs in the arts, sciences and professions are arrayed, there is very little point in attempting to label every unit in this large university as definitively either “professional” or “arts and sciences.” Instead, in this report, we will identify a small group of programs at that end of the continuum in which the preparation for a specific career is the primary, and thus predominant, focus, and we will use these “professional” programs to model our thoughts and suggestions about the professional aspects of graduate education generally. Our hope is that these comments can then be applied as appropriate to other programs, whether primarily in the domain of the professions or of the arts and sciences.¹⁶

The professional schools selected as the basis for our discussion are: the Graduate School of Education–New Brunswick; the Schools of Law–Newark and Camden; and the Graduate School of Management–Newark and New Brunswick, with application also to School of Business–Camden. Although engineering schools, such as Rutgers’ large cluster of programs in New Brunswick, are legitimately described as “professional” schools, for present purposes we see them as much closer to the center of the continuum we have described, because the element of knowledge creation through original research bulks larger than the purely career-oriented aspects of graduate engineering education. Similarly, we do not give our primary attention to programs in the visual or performing arts, although they surely train their students for professional careers.

Significant Changes in Professional Education and Research at Rutgers over the Last Five Years

Enrollments in graduate professional programs at Rutgers have increased slightly in the last five years, from 7,194 in 1992 to 7,565 in 1996, an increase of 5.2%. The enrollment patterns have shifted dramatically, with significant declines in some programs and increases in others. The most significant

¹⁶ One mechanical indicator of “professional” programs is that most are subject to external accreditation controlled by practicing members of the profession, or that students graduating from the programs are expected to sit for licensing examinations, the content of which may influence the course of study within the university. We further discuss accreditation and licensure problems below.

decreases have been in master's programs in Public Policy and Administration in Camden (50%), Public Administration in Newark (49.6%), the doctoral program in Social Work (37.5%), graduate programs in Engineering (36.5%), and the doctoral programs in Criminal Justice (34.6%) and Communication, Information, and Library Studies (33.3%). During the same period, however, several programs had significant enrollment increases, including the recently established Pharm. D. degree at the College of Pharmacy (+141.7%) master's programs at the newly created Edward J. Bloustein School of Planning and Public Policy (+112.5% from its inception in 1993), the master's program at the School of Criminal Justice, and the master's program at the newly established School of Management and Labor Relations (+56.9%). (See Table 14.)

Faculty of Management

Perhaps the most dramatic recent development in professional education at Rutgers has occurred in the administrative structure of management education. First, in 1993, the faculties of the Graduate School of Management and the Departments of Business Administration and Accounting formerly housed in the Faculty of Arts and Sciences–Newark, were merged into the Faculty of Management (FOM) in Newark. Then, in 1996, the consolidation of business education on the two northern campuses was completed with the merger of FOM and the School of Business–New Brunswick, all under a dean located on the Newark campus. The two-stage merger is important as a major test of President Lawrence's oft-stated "one university" theme, in that it reaches across geographically distinct campuses to strengthen and diversify management education and research.

When it is fully implemented, this integrated, two-campus program will both serve and be served by (and draw students from) the largest and most dynamic business community in the world, stretching from the established centers in the New York metropolitan area to the "growth corridors" of Central New Jersey. Organizations in the area are deeply involved in manufacturing, services, and information technology in both domestic and international markets, and entrepreneurship and innovation are important aspects of the business community. Accordingly, FOM is positioned to draw on the expertise and resources of the surrounding community to address a broad range of issues and problems confronting the management profession and to enrich the educational opportunities for our students.

The business programs based on the Camden campus operate separately, reflecting both the greater geographical separation and the distinct nature of the Southern New Jersey business community. The Camden program has concentrated on curriculum expansion to meet the needs of its service area.

Schools of Law

The two law schools are located in Newark and Camden. Reflecting the distinct legal communities in Northern and Southern New Jersey, each school is a well-established presence within its own sector, but each school has also raised its visibility within the national community of legal scholarship. Each school has (or soon will have) a major new physical facility; a major library addition was completed 1994 in Camden; and a completely new building to house the school in Newark is now in the final stages of design, with occupancy planned for fall 1999. In addition, each school has been able to add new faculty, after a period of budget stringency at the start of the decade. In an important, budget-stretching pilot program, begun in 1996, the two schools have jointly offered several specialized courses via distance-learning classrooms, thus avoiding costly duplication of faculty and curriculum.

These tangible developments have important consequences in relationship to several of the most pronounced trends in legal education. First, legal scholarship at the most prestigious schools continues to

shift away from traditional professional areas and towards theoretical and cross-disciplinary studies such as jurisprudence and legal economics; this places an emphasis on recruiting scholars with the requisite multiplicity of skills, and providing them with first-class research facilities. Second, the education of entry-level students increasingly employs the hands-on, “clinical” model (which is facility- and labor-intensive) and emphasizes alternatives to traditional judicial remedies, such as negotiation and mediation. Third, the curriculum (following the practice of law) has increasingly become internationalized. This is a traditional strength of the Camden Law School, and Newark has taken a quantum leap with recent faculty hires and the establishment on the campus of the Center for Global Change and Governance, a major multi-disciplinary resource. Fourth, in the face of a national decline in the number of applicants to law schools, the two Rutgers schools have fared relatively well, experiencing proportionally smaller declines than many competitor schools; as a result, each has been able to maintain its high entry standards. This reflects a combination of strong academic quality and marked affordability relative to many other law schools.

Graduate School of Education

Changes at the Graduate School of Education (GSE) over the last decade reflect the increasing emphasis in professional programs on traditional concerns of arts and sciences faculties. Working within the constraints of a modestly sized faculty and the budget cutting that has afflicted the university as a whole, GSE has concentrated on a key priority in its long-range plan, that of improving the quality of its doctoral programs, with an emphasis on the relationship between professional skills as an educator and accomplishment in cognate scholarly disciplines, particularly mathematics and science education. Similarly, there have been new initiatives and a shifting of resources to other important doctoral programs, such as multicultural counseling and education, educational administration/policy, and literacy education. At the same time, the school has reemphasized, expanded and improved its core programs in initial teacher education, which have benefitted also from the diverse group of new faculty attracted by the doctoral programs.

The increased emphasis on education as a scholarly discipline is also demonstrated by dramatic increases over the decade in faculty productivity (from less than one scholarly article [.46] per faculty member per year in 1986 to 1.70 in 1995); external support (from \$26,154 per faculty member in 1986 to \$157,940 in 1995); and in the percentage of faculty obtaining external support (from 14% to 46%). The percentage of full-time students has doubled over the decade (to 20%), Graduate Record Exams are now required for admission, and the number of doctoral advisees per faculty member has been cut in half (to 6). The number of doctorates awarded has consequently declined, from 93 in 1986 to 37 in 1995, but the quality of the graduate students has dramatically increased.

Professional Education in Strategic Planning

The role of the professional schools is addressed in the *University Strategic Plan*, the ongoing strategic plan implementation process, and the individual plans of the three campuses.

University-Wide Strategic Planning

The overall *University Strategic Plan* does not attempt a comprehensive description (or definition) of professional programs. It identifies law, education, management and public policy as areas of strength, it identifies the field of health policy as a priority for further development, and it highlights the importance of outreach to both the public and private sectors through units such as the Eagleton Institute of Politics and the Center for Urban Policy Research. The *University Strategic Plan* also notes, however, that the “enormous breadth” of Rutgers’ professional programs will require “hard choices” about future support,

and it establishes two general criteria for such support—“fulfill[ing] specific needs of practicing professionals in our state” and “excellence” in teaching and research.

Campus Strategic Planning

The three campus strategic plans vary widely in their treatment of professional programs. The Newark plan is the most detailed, giving separate attention to each professional program on campus and spelling out ambitious resource needs. The New Brunswick plan is the least detailed, and it largely echoes the university's plan in pointing out the need for “hard choices.” It also addresses, briefly, the importance of assisting graduate students in the arts and sciences in their professional role as teachers of Rutgers courses. The Camden plan, like Newark's, gives more individualized attention to each professional program, but in less detail. All three plans identify health care as an area of expansion, thus mirroring the university Plan.

The Role of Specialized Accreditation in Professional Education

As noted earlier, a hallmark of professional schools is that they are often accredited by outside professional bodies whose orientation is toward the practice of the profession, rather than towards education as such.

Background

Appendix 1 contains a list of all Rutgers programs known to have external accreditation. Since a basic premise of academia is that its members, individually and as faculties, should be free to teach and pursue knowledge without outside interference, professional accreditation is an obvious pressure point, and one that sharply distinguishes most professional programs from most arts and sciences ones. A closely related phenomenon is that graduates of some of these professional programs are also required to sit for licensing examinations. Not only does licensure often require graduation from an externally accredited program, but the content of the licensing examination itself can have a potentially powerful influence on curriculum and other academic decisions within the school or program.

Accreditation of Rutgers Professional Schools

In general, these accreditation and licensure standards neither seriously interfere with, nor substantially enhance, the quality of instruction, research and service at the professional schools. Given the aspirations of these schools to be recognized as national leaders, the relevant standard is national peer evaluation, rather than the baseline standards of accreditation. Simply put, as units of Rutgers University, these schools would not be satisfied to stop at the point permitted by accreditation standards.

That said, most specialized accreditation regimens include some requirements that the faculties might not adopt, at least in the prescribed form. The law schools, for instance, are required to spread their course offerings for full-time students across a five-day week, and to enforce full-week attendance by full-time students, a model that may fit rural campuses of another time or place but has little relevance for the older and more urban students of today's Rutgers, who require flexible time to balance complex demands of work, family and school. Faculties are competent to strike the needed balances on their own, without rigid guidelines from the Bar. In 1991, the accreditation standards applicable to management shifted from a “rules” approach to one based on “mission”: more variation in approach is acceptable so long as it serves the clearly stated mission. This is a desirable approach to accreditation.

Licensure requirements render both education and law somewhat more vulnerable, because they vary from state to state and are not co-extensive with accreditation; particularly for schools seeking to supply professionals to a national market, the difficulty of keeping up with requirements that may pose problems

for graduates in a given state can be troublesome. This is not a problem for management, whose graduates do not require licensure for the most part.

Attention to research and scholarship varies in specialized accreditation procedures. To the extent that accreditation is controlled by the practicing elements of the profession, scholarship may count for less, although enforcement of academic freedom principles and requirements for adequate conditions for research are generally positive aspects of most accreditation processes. Where accreditation is more controlled by the academic peer community, a school's research mission carries more weight.

The Impact of Specialized Accreditation in Relation to Other Campus or University Priorities

As noted above, the use (or misuse) of external accreditation can breach the traditional autonomy of academia, in that, as a price of accreditation or reaccreditation, the nonacademician can insist on changes that the school itself, as a matter of academic judgment, or the university administration, as a matter of academic priorities, might not otherwise implement.

There can be no doubt that such impacts occur, at Rutgers, as elsewhere. Perhaps the best-known local example at the moment (the one, indeed, which may well have prompted this aspect of our charge), is the vigorous criticism in the last reaccreditation inspection by the American Bar Association of the Newark Law School's ill-adapted and physically deteriorated quarters, a converted 1929 insurance company office building. Ground breaking is about to occur for a new, \$45 million home for the school which, it is safe to infer, would not otherwise be built at this time.

To note that such impacts exist, however, is not to say that they operate categorically to advantage or disadvantage either the school in question or the broader university community. As to that, we defer consideration to the section on analysis and recommendations below.

The Linkages between the Professional Schools and Public Service

In relationship to the university's overall mission of providing public service as well as teaching and scholarship, a particular virtue of the professional schools is that service flows readily from the teaching and research missions, because the professional schools' focus on applications of knowledge means that students can be taught and new knowledge gained in the course of serving the public, rather than having time spent in service to the public compete to some extent with the other goals.¹⁷ This is not to say that a significant service mission cannot be achieved in the arts and sciences programs of course; rather, it is to emphasize that facilitation of the service mission of the professional schools can be an extremely efficient and cost-effective way of maximizing the overall service accomplishments of the university as a whole.

The range of programs offered by the Faculty of Management illustrates this point. Because FOM views itself as a research institution, a teaching institution, and a service institution, its role within the state of New Jersey is to be a visible force for economic change and development and a facilitator of managerial and business processes. FOM is committed to finding ways to build partnerships with New Jersey businesses, professional firms, public-sector organizations, and entrepreneurs that add value both to the school and to its partners. For example, the presence of business executives in the classroom as seminar leaders and guest lecturers, and as consulting partners on curriculum and strategic planning provides

¹⁷ This is also true of many professional programs in the visual and performing arts, where the performance itself can be simultaneously a teaching vehicle, an exploration of new ideas, and an extremely pleasing experience for the viewing public.

opportunities for networking, interaction and knowledge transfer among members of the business community, faculty, students, and staff.

Over the past few years, many of the activities of FOM have been refocused to accomplish the above. Several dozen conferences are organized each year, including a series of business Roundtables through the Corporate Associates Program at which business executives and faculty come together to examine critical issues. The Distinguished Executive-in-Residence Program has brought three world-class business leaders to the faculty. This has resulted in a distinguished speaker series, exposing faculty and students to chief executive officers of major corporations in the region, and frequent presentations by invited executives within classes at all degree levels.

FOM has an extensive set of outreach programs in place, including the Rutgers New Jersey Small Business Development Center (NJSBDC) which offers training, counseling, and management expertise to small business; the Rutgers Minority Investment Company (RMIC), the only university-based SSBIC in the U.S.; and the Rutgers University Technical Assistance Program (RUTAP), which consults with municipalities to formulate plans for economic development. Each of these activities is carried out by professional staff. To increase faculty involvement, FOM has created a Center for Entrepreneurial Management. The purpose of the center is to coordinate the activities of the outreach programs and to provide a locus for the exchange of ideas between our research faculty and the outreach staff. Currently, the center has an endowment of \$250,000, with an annual income of approximately \$10,000, which FOM hopes to increase significantly so that its ambitious goals can be realized.

The Graduate School of Management's Interfunctional Management Consulting Program, in which teams of M.B.A. students work as consultants with New Jersey corporations and governmental units, is a model which has been emulated by other institutions. Another aspect of outreach is the delivery of off-site degree programs (not, we emphasize, traditional "continuing education" courses). In New Jersey the GSM offers M.B.A. programs in cooperation with Merrill Lynch in Princeton and Somerset, and with Warner-Lambert in Morristown. The school also offers its Executive M.B.A. Program in Indonesia, and the School of Management and Labor Relations offers the master's in human resource management in Singapore and Jakarta. The GSM and SMLR recognize that they must go where the students are, to remain competitive with other regional business schools as well as with national and international schools using distance learning technologies that are proliferating. We note also in this regard that the School of Nursing has been a leader in using distance learning between the Newark and Camden campuses and in other outreach activities. Interinstitutional ties also bring the resources of professional programs to broader audiences. The joint M.B.A./M.P.H. offered by the GSM and the University of Medicine and Dentistry is one example.

Other examples of outreach programs could be given for the schools of law and the Graduate School of Education (and for numerous other professional schools at Rutgers). Rather than extend this discussion, we simply note briefly that through externship programs (Camden) and in-house clinical programs (Newark), the two law schools effectively combine professional training for students with service ranging from representation of individual indigent clients in small matters to massive public-interest lawsuits; Newark law faculty, for instance, have played key roles in New Jersey's nationally significant initiatives in affordable housing and in school finance reform.

Similarly, the Graduate School of Education has cooperated with the New Brunswick Board of Education in developing a model professional development school, the Lincoln School (K-8), that provides a laboratory for educational research, an opportunity for training new teachers and enhancing the

skills of experienced ones, and a vehicle for delivering much-needed service to the school's neighborhood. GSE also has an extensive outreach program, ranging from continuing education courses for teachers and administrators to individual consultations and collaborations with colleagues in the field. GSE has also taken the lead in exploring the use of distance-learning techniques to provide service to the profession, and it has under development a Mathematics Education Institute that will work closely with precollege schools.

In addition to the public-service linkages in management, law and education, which we are highlighting as exemplars of the entire range of professional programs, it is important to note in this connection that the Bloustein School of Planning and Public Policy in New Brunswick and the Master's in Public Administration Programs in Camden and Newark are built around public service to a very considerable extent. The econometric data and commentary that issue periodically from the Bloustein School receive wide public attention and inform many public policy debates in New Jersey, and the Center for Urban Policy Research provides "hands-on" assistance to state and local agencies in the development of new programs and the solution of old problems. Moreover, the policy-oriented professional programs directly train entry-level public managers and contribute to the ongoing training of those already in public service.

Measuring Progress

In common with all graduate programs, there are numerous more-or-less quantifiable measures of "progress" available to the professional schools. As to the quality of the student body, the relevant measures include undergraduate grade averages, scores on standardized admissions tests (GMAT, LSAT, etc.), the quality of source schools, and geographic diversification of the class. Another useful measure is "yield," the number of admissions offers that are required in order to result in a matriculated class of the desired size the smaller the number of offers, the stronger the apparent reputation of the school. As in arts and sciences programs, the financial adequacy of support for doctoral students is a key indicator of program quality and—at the same—time a key stimulus to improving the student body. It must be recognized, however, that many professional programs are not based on doctoral study, and in these programs, the adequacy of scholarships plays an equivalent role.

With respect to faculty, the ability to recruit strongly credentialed entry-level teachers and well-regarded experienced scholars from other schools is important. A measure of progress is the increase in scholarly productivity and the ability to sustain productivity across an entire career, rather than having it dwindle away after tenure or promotion. Care must also be taken not to confuse sheer quantity with quality; the ability to disseminate research through increasingly more prestigious journals, conferences and other forums, and evidence that the research is relied upon by others are at least as important. Where relevant, external grant support is a significant measure of quality, but many professional fields (including both management and law, for instance, have relatively small amounts of external funding available overall, a fact which must be kept in mind when using this as a measure of quality.

Logically, the worth of a professional faculty ought also to be measured in part by the quality of its teaching and its service, since these are coequal parts of the stated mission of the university and the various professional schools. It has proven difficult, however, to derive objectively reliable measures of teaching effectiveness; student surveys are often little more than popularity contests. One measure of progress that inferentially captures teaching effectiveness is the ability to place graduates in professional positions. It is also important, however, that a fairly long view of "progress" be taken here, because professional jobs are inevitably tied to the ebb and flow of the economic cycle, and the enduring quality of a faculty, its curriculum, and its research, can be harmed if it responds too quickly to short-term changes in the market. As for service, it, too, is difficult to gauge, because there is no standard unit of service quality or quantity.

One approach is to measure service indirectly, through successful student output (service as training) and through faculty productivity (service that stimulates research and scholarship).

It should go without saying that infrastructure is a powerful indicator of program quality and progress. While it is abstractly possible to run a world-class program out of a third-rate facility, neglect of surroundings more often than not accurately bespeaks neglect of the program itself. This is literally true with respect to direct support of teaching and scholarship: without adequate research collections, staff support and, in today's world, computing, word processing and communications technology, improvements in the quality of the program become very difficult. The relationship is also true, however, even in a less literal sense. A shabby building, email that doesn't get through, and so forth, communicates to the outside world of peers that the program is neglected, and reputation itself is an important indicator of program progress.¹⁸

We emphasize that these indicators of progress in a professional program are not the substance of quality itself. A good program getting better does so because of strong leadership, faculty dedication, a sound curriculum, and an *esprit de corps* among students, faculty and staff, none of which can be reduced to mechanics. However, where the indicators we have identified are present, it is highly likely that the program itself will be making progress, and we believe that to be true of the programs we are using as examples in this report. Of the various factors we have mentioned, the only significant ones that suggest a lack of progress are the failure to draw students widely from outside New Jersey and neighboring states, levels of student support that are not conducive to recruiting even better students than the very good ones these programs enjoy, and difficult problems with infrastructure support other than home buildings which range, on the whole, from good to excellent.

ANALYSIS AND RECOMMENDATIONS

The Direction of Professional Education at Rutgers over the Next Decade

In each of the professional areas we have been highlighting—management, law, and education—the Rutgers programs are large and well established. For each, the changes likely to take place over the next decade are incremental, although if current political initiatives emphasizing an improvement in quality of public elementary and secondary education bear fruit, this may provide an opportunity for the Graduate School of Education to move somewhat more rapidly.

The direction of the incremental changes that are likely is indicated by the description of trends and developments in the preceding section of this report: increased synergy between academia and the profession itself, to maximize the opportunities for teaching effectiveness, scholarly productivity, and contributions to public service; increased internationalization of the programs (this is particularly true of management and law, although we note also GSE's collaborative work with universities in Japan, Russia,

¹⁸ Having mentioned reputation, we consciously reduce to a footnote the consideration of national rankings as a measure of progress. Certainly, rankings by nonacademic commercial sources, such as the various news magazine polls, are virtually worthless, since the criteria and weightings are far from scientific. Even peer rankings must be used cautiously, since they often overstate the importance of reputation, which may anticipate by several years or lag behind the actual condition of the unit, of which the ranker may have little direct knowledge. That said, we freely admit that it is asking too much of human nature not to trumpet high or increased rankings, when one has them.

Ukraine, China and Israel); and a drive to become nationally recognized within the top echelon of programs.

As to this latter goal, each of these programs (and other professional programs at Rutgers as well) has elements that are already at the level of national prominence, and each has the capacity to improve to that level. But Rutgers' professional schools are not alone in stating this goal of progress; numerous other schools are also positioned to make a move up, and national preeminence thus involves a constantly shifting frame of reference. What will determine Rutgers' success, all else equal, is the degree of incrementalism that is imposed by the overall resource limitations of the university. Money alone will not buy success, but if lack of money forces tiny steps in terms of student recruitment, faculty accomplishment, and program infrastructure, lack of progress is virtually assured.

Another important goal (although one which, happily, can be categorized as incremental at Rutgers) is to continue progress towards diversification of the professional faculties and student bodies. Current data on women and minorities show that management, law and education have been attentive to this issue and have made progress, considerable progress in some instances. Nonetheless, it is crucial that further progress be made. Women and minority faculty provide important role models for students (including undergraduate students contemplating professional careers) and for people at large, as these faculty members come into contact with the public in their public-service roles. Women and minority students help to improve the quality of education within the professional program, by helping to ensure that a wide variety of perspectives is brought to bear in every classroom. And, finally, our society at large will never achieve its stated goals of race and gender equality if the professional schools do not send forth a well-trained pool of entry-level professionals who can succeed on the basis of talent and skill. Affirmative action programs are under attack nationwide, and the next few years will be crucial ones, politically and in the courts. The professional schools must be active as the debate unfolds; law, management and education all have specific roles to play in insuring that the values of diversity are understood. And, if necessary, creative new ways must be found to continue the diversification that has already begun.

An important concern throughout the university over the next decade will be the growth of graduate and professional programs at other New Jersey institutions. These have already begun to proliferate in the wake of the state's decision to abolish the Department of Higher Education, which heretofore has had some degree of control over the quantity and quality of such programs. Professional programs are particularly vulnerable to this trend because of the ready marketability of job- and skill-training opportunities in New Jersey's rapidly changing workplace economy. This has already occurred in nursing. Rutgers need not be concerned about the qualitative depth of its programs, nor its ability to attract strong students, and there certainly are nonacademic training programs (paralegal studies, for instance) that do not belong in a university setting. The serious issue is whether an unplanned proliferation of programs will divide resources and enrollments among too many schools, damaging Rutgers' ability to improve to the highest levels nationally, and particularly undercutting its research mission, which many of the startup programs slight.

Striking the Proper Balance between "Scholarly" and "Professional" Emphases in Graduate Education

As we have already indicated, scholarly and professional interests lie along a continuum in graduate education, rather than forming a dichotomy. Even in those programs that cluster towards the "professional" end of the scale, however, there are important linkages to the traditional concerns of scholarship that must be recognized.

Professional Programs Oriented toward Scholarship

The organizing question here is: by what criteria ought professional programs offer the Ph.D. degree? The answer is slightly different for management, law and education.

The Ph.D. Program in Management, offered by the Faculty of Management (FOM) in conjunction with the New Jersey Institute of Technology and administered by the Rutgers Graduate School–Newark, has as its goal the training of students for positions in research universities. The program has graduated a total of 86 students, most in the last six years. At present there are approximately 150 students enrolled, about two-thirds full-time. The quality of the graduates, especially the most recent ones, is attested by their presentations at national conferences and their publications in respectable journals. The quality of the applicants to the program has also been increasing steadily as faculty and graduates have become more visible in the academic community. While many of the graduates have taken positions in New Jersey institutions and many international students have returned to professorial positions in their home countries, FOM aspires to place more graduates at research universities comparable to our own.

Most law schools do not offer a traditional Ph.D. program (or its grandly-named equivalent, the S.J.D.—Doctor of the Science of Jurisprudence). A doctorate is not an entry-level credential for teaching positions, and the basic professional curriculum places a sufficient emphasis on the research skills necessary to practice law, so that a formal research degree has little relevance.¹⁹ As law becomes increasingly interdisciplinary, however, there will be a need either for law teachers who have independently obtained a Ph.D. in some cognate field, or for both lawyers and teachers who have earned a joint degree, that is, a first degree in law combined with simultaneous study leading to either a master's or a Ph.D. in the cognate field.

The Graduate School of Education offers yet a third model. It currently offers the Ed.D. degree, rather than the Ph.D., but it is actively considering adding several Ph.D. programs at this time. The crucial distinction here is that the Ed.D. traditionally serves the professional needs of teachers as they progress along their career paths, while the proposed Ph.D., as it has evolved at other respected schools of education in subfields such as mathematics education, would facilitate a much more expansive linkage between abstract mathematics and professional teaching, to the benefit of both disciplines.

The common principle to be drawn from these three different examples is that award of the Ph.D. degree must be justified, program by program, as it has been with management and is in the process of being with education. Conversely, the Ph.D. must not be regarded simply as a trophy for a professional program seeking greater recognition. As indicated by the different pattern in law and parts of education, the finest program need not necessarily be a doctoral one, if the mission of the school does not require it.

The Scholarly Needs of Professional Faculties

There is another important overlap between scholarship and professionalism, one that is often overlooked. While most graduates of professional schools will head out into the workplace and stay there, a certain number will (indeed must) ultimately return to academia as teachers and scholars. There, they not only train the next several generations of practitioners, but also act in a very real sense as the keepers of the

¹⁹ To the relatively small extent that there is a demand for the S.J.D., it is accommodated by a small number of extremely prestigious schools, whose “cachet” accounts for the attractiveness of the degree itself. Doctoral programs in law are not warranted at Rutgers.

profession itself. Scholars are given the precious gifts of time and material support by their universities, and that is no less true of scholars within the professional disciplines than it is of any others. Released from the need to service clients, they are expected to devote a significant portion of their time to mastering the intellectual context of the profession so that its past can be understood and its future can be charted. The distinct context of operating within a profession as well as a university poses some particular challenges for professional scholarship, however.

First, it is virtually a given that scholars in a profession must have practiced their trade for some time in order to have competence to return to academia as teachers, and many do not form even their long-range decision to become scholars until after they have left the university. Thus, they return to academia without the period of apprenticeship in teaching and research that most young scholars in the arts and sciences have, and they must be given support in their early years of university service that recognizes their different needs.

Second, scholars of a profession necessarily work within the parameters of that profession. They are not unique, of course, in needing to speak the specialized language of their discipline, but to a greater extent than in many arts and sciences disciplines, their ultimate audience includes practitioners, as well as other scholars, and this may affect how they present their scholarship, and in what forums. The audience for legal scholarship, for instance, includes lawyers and judges as well as law professors, because the ultimate test for the success of legal discourse is the acceptance of new ideas into the everyday practice of law. Unlike the theory of relativity, law cannot be “proven,” but instead must be “accepted.” The duality of mission which differentiates the graduate/professional school faculty from the faculty of arts and sciences is particularly troublesome for GSE, because of the long-standing ambivalence that major research universities have had about institutionalizing a commitment to education at the polar-opposite end of the scale, i.e. K–12 elementary and secondary education.²⁰

The obvious pressure point for reconciling these distinctions between scholarship in the arts and sciences and in the professions is the system for appointing, promoting and tenuring faculty members. Concern about personnel decisions is a recurring one in many of the professional faculties. While the obligation of any discipline to justify its decision to intelligent outsiders can be a salutary check on parochialism, care must be taken to understand the various ways in which scholarship of quality can be manifested in the professions, particularly where the ultimate decisions are centralized (as at Rutgers) and therefore not primarily in the hands of those who understand the profession best. Failure to take that care inevitably undercuts the cause of quality itself, because promising young scholars will seek out institutions of at least equivalent reputation that they perceive to be more hospitable, even if perception outruns reality. The change in PRC practice which permits deans to appear in person to discuss problematic cases has alleviated some of the potential for misunderstanding in this area.

Relationship to Arts and Sciences Programs

In some professional disciplines there has always been a strong link to a related program in the arts and sciences. An obvious example is the relationship between the various fields of engineering and the cognate fields of basic science. All GSE programs work closely with the corresponding discipline departments:

²⁰ In a recent, seminal report, *The Role of Universities in K–12 Education* (1995), the American Academy of Arts and Sciences argued strongly that research universities must become much more involved in the improvement of K–12 education, noting that this will require “something of a culture change” (pp. 3–4).

science education works closely with physics, chemistry and biology; mathematics education works closely with the mathematics faculty; and so on.

Other interdisciplinary linkages are of more recent significance. There are also important linkages between professional programs themselves, such management and law, management and public administration, nursing and public policy, for instances. The linkage may even be internal to a specific program. The Faculty of Management's innovative Business and the Arts Program, for instance, provides MBA students with exposure to the arts through field trips that provide a behind-the-scenes look at artistic activities and include discussions with the artists, producers, and executive volunteers involved. Through an elective course, students receive degree credit for their practical experience as project consultants with arts organizations. Such programs can also foster both intellectual and financial linkages between artists and their traditional corporate patrons.

The desirability of interdisciplinary programs is no longer open to question, and has been specifically embraced by the *University Strategic Plan*. Continuing attention must be given, however, to the mechanisms that will make collaboration across disciplines thrive (including such crucial but relatively low-visibility concerns as how collaborative work is budgeted and what forms of accountability are necessary). One important mechanism—establishment of centers, bureaus, and institutes (CBIs) that draw from various faculties—is separately discussed by another subcommittee; we note only that while Rutgers has experienced some recent problems with CBIs, the value of these institutions when they function smoothly should not be forgotten.

A particular barrier to interdisciplinary work is Rutgers' three-campus dispersal, intensified by the clustering of some of the larger professional programs in Camden and Newark. (Where strong joint-degree programs currently exist, they are often between professional schools on the same campus, such as the J.D./M.B.A. and J.D./M.P.A. programs in Camden.) Intercampus programs do exist, for example the law/public policy program of the law school in Camden and the Eagleton Institute in New Brunswick, and the law/planning program between the law school in Newark and the Bloustein School in New Brunswick.

However, most programs rely on the resources available on a single campus. The existence of strong professional programs in Camden and Newark is a reason to ensure that cognate arts and sciences programs are also as strong as possible on those campuses; when new programs have locational flexibility, the opportunities for interdisciplinary connections should be an important factor in making a choice; and, because intercampus collaborations are inevitable, the university's strong commitment to distance learning infrastructure, announced in the *Strategic Plan*, should be implemented for scholarly exchanges (for instance, to facilitate the participation of colleagues on all three campuses in a specialized faculty seminar) as well as classroom ones. Needless to say, superior computing facilities for email and data are also essential.

Professionalism in Arts and Sciences Programs

From the continuum model that we have sketched, it logically follows that attention to professionalism is as appropriate in arts and sciences disciplines as are the underlying concerns of arts and sciences in the professions, although obviously the balance will be differently struck. In striking the balance anywhere along the continuum, the key is to understand clearly what society expects of our graduates in any particular discipline or component thereof, how our graduates will be using their education, and the limits of what is best learned within and outside academia.

We caution only that, to the extent that attention to professionalism is given in graduate arts and sciences programs, it must be treated seriously, rather than as some faddish add-on to the “real” program. Better not to do it at all than to do it ineffectively.

Professional Education and Long-Range University Planning

As we noted in describing the current state of professional education at Rutgers, the *University Strategic Plan* acknowledges the importance of the professional schools in the university’s mission. Significantly, however, it also announces that hard choices will have to be made in deciding which professional programs can be supported because of the enormous breadth of the existing programs. Because the *Strategic Plan* is written at a high level of generality, the hard choices strategy is not spelled out, and this leads us to several comments and suggestions.

First, we are concerned that in other sections of the *Strategic Plan*’s discussion of areas of growth, it either identifies positively those programs meriting support, or it emphasizes that savings can come from eliminating duplicate programs. Only in the area of professional studies does the plan imply that there are too many programs to support, apart from their individual strengths. Weak or outdated programs should always be candidates for reconsideration, but this is true across the board, not just in the area of professional studies, and the plan should reflect this. If the *Strategic Plan* means, more broadly, that too high a proportion of the university’s budget is devoted to professional education, in relationship to other graduate programs, or to undergraduate programs, such an implicit and unexamined premise needs to be made explicit and examined carefully. There are neither data nor principled arguments on the table at the moment to support such a conclusion.

Second, in stating criteria for the support of professional programs, the plan identifies excellence in teaching and scholarship, without adding the component of excellence in public service. As we have already indicated, and will discuss again below, service is a uniquely strong component of most professional school programs and these programs are therefore a principal means of discharging the university’s overall commitment to public service, as well as to teaching and scholarship. We do not suggest that the university can realistically support many service-only programs, but excellent service programs should not be irrelevant when considered alongside excellence in teaching and scholarship as the hard choices are made.

Finally, we note that the *Strategic Plan* does not establish a benchmark for a fair share of the university’s resources that should be allocated to professional programs as the hard choices are made. The plan implementation process described earlier suggests that there is a meaningful commitment to sustaining established programs and expanding in the health care area, as the *Strategic Plan* proposes.

That said, the process itself has generated some anxiety in many quarters of the university, not limited to the professional schools. The plan implementation phase, while involving literally hundreds of faculty members, was conducted on a very tight timetable that made in-depth review difficult if not impossible, thus risking at least the appearance of superficiality, despite the dedicated work of many individuals. Moreover, the relationship between the strategic planning process, the projected capital campaign (new money), and the allocation and reallocation of existing resources, has not been fully clarified. Raising money for new projects, and painfully reallocating limited funds to existing programs, are very different dynamics. The creation in the 1996–97 academic year of a distinguished faculty committee to oversee the strategic resource and opportunity analysis (SROA) process, and further attention to the internal public

relations necessary to explain the ongoing process, should go a long way towards relieving any appearances problems.

As a consequence of the high level of generality in the *University Strategic Plan*, it does not, for the most part, address the specific issues raised in the three separate campus plans. This is most obvious in relationship to Newark's, which is the most detailed of the three. There is certainly virtue in having a brief strategic plan document, one that focuses on overarching themes, but some way should be found, through appendices, or a separate document, or approval of the campus plans, to know in what respects they can speak authoritatively for campus-level strategies. The President's Cabinet, composed of the Newark and Camden provosts and the university's senior vice presidents, will play a critical role in ensuring that the campus strategic planning priorities are well represented in the implementation of the university's plans over the next decade.

Specialized Accreditation and Professional Education

External accreditation of professional schools is a fact of life. Not only is the concept unlikely to be abandoned anytime soon, but it should not be. External review is particularly important for professional schools, because of the close connections to the practice of the profession that are inherent in professional education and scholarship. Even apart from this particular consideration, however, external reviews stimulate self-examination in the light of peer standards at comparable and superior institutions, and thus are a key element in improving the quality of any educational program, professional or otherwise. The truth of this observation is demonstrated by the university's external review system overseen by the Committee on Standards and Priorities in Academic Development (CSPAD), which has successfully brought external reviews to units that are not otherwise covered by standing accrediting bodies.

The problem, if there be one, is that in the external review process accrediting agencies have a peculiar power to use the threat of denying accreditation as a bargaining tool in the internal competition for university resources. It is not the power itself that is the problem; it is the potential for unfair use of the power, and this, unfortunately, is very difficult to evaluate objectively.

The dimensions of this potential problem must be kept in perspective, however. First, we note that accreditation issues that become problems normally turn on resource disputes; where the issue is poor leadership, for instance, solutions are more readily forthcoming, even if they are painful, because a solution is largely possible within the unit in question. A second important perspective is that tight accreditation standards protect institutions such as Rutgers, whose general standards are high, from being hurt in a "race to the bottom" competition with practice-oriented professional schools that may turn out trained, but not educated, graduates.

Finally, a very important element of perspective is to note that a CSPAD-supervised external review of a program that does not require accreditation may also turn up a serious problem (inadequate or deteriorated physical facilities, to use a typical example). That may very well stimulate the university to allocate resources to the solution of the problem, so that the university's overall goal of program excellence does not suffer from negative peer evaluation. The threat of loss of accreditation undoubtedly adds an edge to the debate when hard choices must be made, but the hard choices are there in any event.

The best solution, of course, is to ensure that programs, accredited or otherwise, are not let slide to the point where external review problems are predictable. With respect to resource issues, adequate year-to-year support is, in the long run, cheaper than major fixes once the problem has accumulated larger proportions. We recognize, of course, that the university's overall resources are limited, severely so in

recent years as state support has declined. This fact, however, is not inconsistent with our emphasis on incremental attention to problems that might invite pressure from accrediting agencies, for two reasons.

First, if the general system of resource allocation for the university relies on diverting resources from programs A, B, and C to build up D, followed by diverting resources from B, C, and D to allow A to catch up, and so forth, then the appropriate unit of comparison is the long term, rather than the briefer “catch up” period. An inequitable distribution over the short run may be much more equitable over the long haul. Second, if the long-term projection is that resources will not be able to support all programs (accredited or otherwise) at the desired level of excellence, then the hard choices of which the *Strategic Plan* speaks should be made sooner, rather than later, so that there can be adequate support for those programs (again, accredited or otherwise) to which the university remains committed.

All of that said, there remains the possibility that the accreditation process will be misused in some instances. We note, moreover, that this can occur not only when an accredited unit uses the process to pressure the university unfairly for additional resources, but also where the accreditors unduly emphasize practice-oriented instruction at the expense of what the faculty believes to be appropriate academic requirements. In either event, it will be difficult for the university to act unilaterally to protect its own interests or those of its constituent faculty. Bluff-calling is possible—major programs at major universities are not likely to be denied accreditation on flimsy grounds, once subjected to the glare of publicity—but students become innocent pawns in this approach, and the uncertainty may also adversely affect recruiting. Much more preferable is for universities to act collectively to identify pervasive problems and work with accrediting agencies in resolving them. We note in this regard that in 1996 the American Bar Association agreed to an antitrust settlement with the U.S. Department of Justice, under which it agreed to discontinue some aspects of its standard accreditation review.

Balancing and Integrating Professional Education with Undergraduate Education

Law, education and management, the three professional disciplines that serve as our examples in this report, take very different approaches to undergraduate education.

At one extreme, law schools traditionally have had little interaction with undergraduate education, at least in part because licensure of lawyers in most states (including New Jersey) requires a graduate degree. Nonetheless, law is an important component of the social order, courses about law are routinely offered in undergraduate liberal arts majors such as political science, and more extensive interactions among law faculty, their liberal arts counterparts, and undergraduates should be encouraged.

The education of new primary- and secondary-school teachers, on the other hand, has traditionally been predominantly (if not exclusively) a domain of undergraduate schools, but this format has not always fit comfortably with the stated mission of major research universities. Thus, Rutgers has emphasized a graduate model for its school of education, but it nonetheless has small undergraduate programs on each of the three campuses. These programs are independent of GSE in Newark and Camden; in New Brunswick, GSE has recently implemented a five-year combined bachelor’s/master’s programs in cooperation with the related “content” departments. This is a promising development, but whatever the form, the most important principle for undergraduate programs is that they maintain and develop strong linkages to other undergraduate liberal arts disciplines. Graduates should be well grounded both in teaching as a profession and at least one substantive discipline as well.

The most expansive relationship between graduate and undergraduate professional education is in the FOM which, as a full-service center for management education, actively provides undergraduate degree

programs on the Newark and New Brunswick campuses. A similar, but smaller graduate/undergraduate relationship exists within the management program in Camden as well. (We note also that undergraduate programs in public administration in Camden and Newark, and the program in criminal justice in Newark, share with FOM this strong overlap between professional and undergraduate training.)

FOM's two undergraduate programs (School of Management–Newark, and School of Business–New Brunswick) differ markedly with respect to student preparedness, standards of performance, and curricular requirements. The two programs, having developed independently under different faculties and deans, are vastly different, each appropriate to the student body served. Each undergraduate program enrolls approximately 900 matriculated students. Each is an upper-level program (juniors and seniors) offering both day and evening classes. As a result of the more narrow catchment area available to a commuting college, frequently characterized by urban high schools with their well publicized difficulties, most standard measures of incoming student quality show the average test scores of those attending SOM to be below those of SB–NB. The latter, as an upper division residential school drawing from the six undergraduate schools on the New Brunswick campus, enrolls an entering population better-prepared to address the most demanding of business curricula.

FOM is currently grappling with the resultant issues: many on the merged faculty are quite concerned about differences in standards and are committed to reducing the gap between admission standards in the two programs. Others believe the differences in the mission of the two campuses and in the needs of the student bodies must be respected. This new environment of a common faculty offering programs for two disparate student populations provides an ideal laboratory in which to study the learning process and develop means appropriate to each group. The faculty has been approaching this through new curricular requirements.

Historically, most business undergraduates go directly into the job market after graduation, pursuing graduate or professional education after several years of work experience. FOM's programs attempt to prepare both the diverse and multicultural student body of SOM and the more traditional student body of SB–NB to enter that job market and compete successfully, and to equip them with a degree that is recognized and respected as superior to those awarded by our competitors in the state.

The undergraduate programs of the visual and performing arts professional schools require a special mention here. Artists, actors and ballet dancers, unlike accountants and school teachers, have a structural uncertainty about their job prospects because of the always-parlous financial state of most arts organizations, the unpredictability of talent, and the fickle factors of timing and luck that seem to govern artistic success to an immoderate degree. Playwrights are more likely to wait on tables than are civil engineers. Because this is so, it is particularly important that undergraduate professional programs in the arts sensitively balance professional training with enough elements of a traditional liberal arts education so that graduates will be at least as well prepared as literature or history majors to find their way in the world if the dream of stage or screen fails.

NATIONAL ISSUES

As the great American universities developed their modern form in the late 19th and early 20th centuries, professional education was often outside academia altogether, accomplished either as on-the-job training or in trade schools that did not purport to embody the traditions of the arts and sciences. Where

professional education was placed in an academic setting, it was often consigned to a consciously secondary role, as in normal schools for the young women destined to become schoolteachers.

Reception into academia has been a significant factor in upgrading the quality of the professions themselves and, in turn, providing a base for abstract study of how any profession can and should serve society. But these immense benefits are not achieved without some tension. The study of law or business is still primarily intended to equip graduates to venture forth and practice the skills they have learned, rather than (as, for instance, with a research scientist) to move on to another academic setting to build the next generation of knowledge. Professionals tend to speak a different language than academics do, and thus professionals within academia must be bilingual, and their university colleagues must be sensitive to legitimate differences with respect to modes of teaching, scholarship and service. Intellectual rigor should be a constant, but with a diversity of means.

This tension is also apparent in the relationship between faculty and students within a professional program. With the exception of those in well-conceived, research-oriented doctoral programs, professional students tend to emphasize the practical, rather than the theoretical, aspects of their training. Yet increasingly, professional faculty are turning to theory, spurred by legitimate university insistence on meeting rigorous intellectual standards for hiring and retention. Ways must be found to prevent this gap from widening. Careful use of part-time and adjunct faculty from practice is one possibility. Outside professional constituencies (such as accrediting and licensing agencies) should be encouraged to provide professional incentives for more theoretical work, particularly for professionals who return to school after a period of practice. Additional interdisciplinary teaching and joint degree opportunities should be created, so that professional faculty have appropriate access to their arts and sciences colleagues.

Finally, we wish to emphasize the important role that professional schools play as “keepers of the flame.” As we have noted, the inevitable ebb and flow of the economy will expand and contract the number of students seeking any given professional degree at any given time, just as the ebb and flow of culture and politics may place historians in demand in one decade and rocket scientists in another. Professional schools, like their arts and sciences counterparts, must be alert to the emergence of new disciplines and the fading away of others, but in neither case should core values be held hostage to short-term fluctuations. Thus, we submit, the sole question in evaluating the role of professional programs within the university cannot be short-term enrollment trends. A great modern university must keep the conscience of the professions, just as it seeks to keep the spirit of classical learning alive even after the contemporary definition of educated person has changed. This is no easy task when, as appears to be the case at present, support for higher education is on the wane. We must see our purpose as a common one, however, for we in the professions and we in the arts and sciences are indeed one university.

RECOMMENDATIONS

RUTGERS' ACADEMIC COMMUNITY

Enrollments

- In making decisions concerning graduate enrollment management, Rutgers should take a long-term view and not allow cyclical economic fluctuations or short-term trends in the job market to determine programmatic priorities.
- Within the context of constrained resources, Rutgers should pursue the most qualified students for doctoral education and provide them with the financial support necessary to complete their course of study in a timely way and with minimum postgraduate debt.
- In order to mitigate the insidious effects of rising tuition and concomitant student debt, Rutgers must make adequate student financial support a major part of its graduate-enrollment management practices.
- Rutgers should strive to recruit only the most promising international students and should ensure that recruitment efforts are not confined to limited geographical regions. Enhanced formal and informal networks with foreign universities are key to achieving this goal.
- Additional efforts need to be made by doctoral programs to attract, retain, and graduate qualified students from underrepresented groups. Summer institutes, mentoring programs, special recruitment efforts, and appropriate academic and social support groups have yielded positive results and should be expanded and enhanced.

Minority and Diversity Issues

- The benefits of a diverse student body are well understood, but considerable inequities remain. Diversity in the student body helps to ensure that the largest possible pool of highly qualified people is available to carry forward the work of the universities and the nation. Using creative approaches, Rutgers should continue to seek students from historically underrepresented groups, should continue to seek expansion of the pool of qualified candidates, and should continue to develop appropriate support programs to ensure that students succeed in the graduate-school environment.
- Inequities in education and in the larger society have had deleterious effects on students' preparation for advanced academic work. Rutgers should continue to play an assertive and active role in strengthening basic education, including precollege and college enrichment programs.

Graduate Curriculum

- Graduate programs should be designed to educate students broadly and not simply train them vocationally. There must be sufficient intellectual rigor in the programs to prepare students for long-term critical thinking in a discipline. This educational preparation will provide a means by which individuals can contribute to a field long after the narrower aspects of training in a single discipline become obsolete. To improve Rutgers' position within the ranks of the AAU,

a major priority must be to enhance even further the doctoral programs which have already earned Research University I status and strong representation in National Research Council ratings for the New Brunswick campus. Another priority must be to maintain and strengthen the mix of professional, doctoral, and master's programs which characterize the Newark campus. At Camden, professional and master's programs must be maintained and strengthened, and decisions need to be made regarding the possible development of doctoral programs.

- Graduate programs should consider means to broaden the doctoral curriculum and allow students opportunities to explore a wider number of avenues for research. Innovative programs such as those being supported by NIH, which allow students to explore a wide range of laboratory science options before choosing a research focus, should be widely promoted, not just in the sciences, but in the social and behavioral sciences and the arts and humanities as well. Industrial internships and the substitution of multiple published refereed publications for a single comprehensive dissertation should be discussed and considered as novel ways of enhancing the breadth of the doctoral curriculum.
- Individualized mentoring plays a critical role in graduate education. Faculty should be encouraged to formalize mentoring programs to enhance students' research capabilities and students' teaching methods. Rotation of students through different research laboratories, and progressive responsibilities, coupled with close supervision in the research setting and in the classroom, will provide students with practical experiences that will be useful in postgraduate employment in academia or elsewhere.
- Universities need to ensure that graduate students get sufficient training and experience in teaching to enable them to assume responsibilities as instructors upon graduation. By providing all students with some teaching experience, and giving teaching assistants progressive responsibilities as instructors, graduate students can develop these critical skills. Preparation takes various forms, including general orientation workshops, development of teaching portfolios, teaching awards, and especially training sessions developed by individual graduate programs. The role of faculty in mentoring graduate students in the acquisition of teaching skills should be enhanced.

Development of Career Paths

- Prospective and currently enrolled doctoral students would benefit greatly from a clearer understanding of job prospects and career paths open to them when they complete their degrees. Individual graduate programs should consider maintaining and cataloguing lists of recent Ph.D. graduates and current positions; forming placement committees to provide general advice on career services; providing annual information sessions on preparation for diverse career options; developing joint industry/university initiatives to aid recruitment of graduate students and to acquaint aspiring scientists with career options (for example for chemists in the pharmaceutical industry); and establishing initiatives to place graduate students in industrial internships. Methods used effectively in the professional schools can serve as models in the development of appropriate placement programs in the arts and sciences.

Time to Degree

- While many factors affect the total time-to-degree, Rutgers needs to ensure that students use their time in graduate school effectively. In many disciplines the strongest graduate programs have shorter times to degree than do the weakest ones. By recruiting well-prepared graduate students, providing them with adequate supervision and financial support, and providing well-defined curricular objectives, the university can help students advance to candidacy in a reasonable time frame.
- Financial and intellectual support for graduate students is critical to their success and directly affects retention and times to degree. While time to degree is obviously affected by the amount and type of support students have, the less tangible support of peers and faculty members may be equally critical. Students at the dissertation research stage should have committees, composed of faculty and perhaps other students, with whom they meet on a regular basis to assess whether or not significant progress on the thesis has been achieved. This regular feedback can help avoid the all-too-frequent isolation of the graduate student, a condition which only serves to delay further the completion of work. In addition, students should have assistance with realistic career planning, whether employment is anticipated within academia or elsewhere. Contacts with professionals in a wide range of areas can provide students with a greater understanding of their postgraduate opportunities, and can encourage them to complete their graduate work.

Postdoctoral Associates

- Nationwide, postdoctoral appointments are critical to research and graduate programs. These associates are generally highly motivated to perform innovative, ground-breaking research, and they play a critical role in assisting faculty in the research training of undergraduate and graduate students. Consequently, the manner in which postdoctoral associates are treated at Rutgers is of great concern to faculty members in many fields, particularly in the experimental sciences. Inadequate critical support is one of the key issues. In fields in which professorships are in very short supply some mechanisms should be developed to allow postdoctoral fellows to continue on their career paths. Annual appointments as research associates may help in this process, and university policies with regard to continuing appointments, salary, and benefits should be reviewed and updated regularly. In addition, pilot programs to reward exceptional postdoctoral associates should be considered.

Retirement Issues

- Recent changes in federal law regarding retirement have brought imbalance to the number of faculty at different levels at colleges and universities. These new laws may profoundly affect research and graduate education. Retirement incentives, in addition to the traditional monetary and health benefit retirement packages, are needed to encourage older, tenured faculty members to retire so that new junior appointments can be made. The university should reinstate and/or strengthen emeritus programs, and should encourage senior faculty to remain active. Thoughtful, individualized solutions made in the context of individual needs and interests, so as to ensure that reasonable productivity is maintained, should be developed.

Data for Policy Making

- In order to develop well-informed answers to questions about appropriate numbers of students in the sciences and humanities, time to degree, matching curricula with postgraduate employment, appropriate financial support, etc., it is essential that a variety of statistical data be available in easy-to-comprehend form. One of the major recommendations of the COSEPUP report was to establish more timely and accessible databases. Rutgers needs to devote the resources necessary to establish and maintain such databases for assessing a wide range of institutional issues, including program effectiveness, recruitment and retention issues, time to degree, and postgraduate employment issues. Rutgers' ability to make timely decisions concerning the investment of its resources for graduate education, to enhance its reputation for intellectual excellence by increasing its attractiveness to the best graduate students in the nation, and to respond to market forces in ways which will strengthen its ties to industry, depends on the quality and availability of this information. In addition, Rutgers should continue to play an active role in enhancing data comparability among institutions so that national trends can be assessed reliably; and in devising effective means for using these data in key decisions regarding resource allocations and decisions to suspend programs or develop new ones.

Infrastructure Needs

- Graduate programs require significant investments in physical plant, equipment, and staff support. While it is abstractly possible to run a world-class program out of a third-rate facility, neglect of surroundings more often than not accurately bespeaks neglect of the program itself. Programs require infrastructure for direct support of teaching and scholarship: adequate research collections, staff support, computing and communications technology, appropriate physical facilities, and functioning support systems, such as email. Rutgers must continue to invest in these areas, even when under considerable pressure to put these needs aside in favor of needs for programs that more directly benefit faculty and students, such as faculty recruitment, employment benefits and/or scholarship and fellowship programs.

Advisory Councils

- University advisory boards comprised of the best research faculty can provide administrative officers with critical advice, strategies, and high-quality peer review focused on specific academic areas. For example, a science council, composed of prominent research faculty at the university, with accessory members from the University of Medicine and Dentistry of New Jersey, would be able to work closely with top levels of administration to provide information and recommendations on myriad science and research-related issues, including: communication of the importance of research to the public and to government officials; strategies for increasing the number of federal fellowships and training grants in the sciences; suggestions for collaborative, interdisciplinary research that could increase the likelihood of obtaining large blocks of federal funding; and descriptions of recent discoveries and innovations in fast-moving fields of research.
- Rutgers should create university-wide faculty advisory councils covering broad disciplinary areas (such as the humanities, social sciences, physical sciences, social service professions, etc.) in order to help foster regular communications among faculty and administrators about

graduate/professional education and research. A university-wide advisory board consisting of industry leaders can be an important resource for improving and supporting graduate education at Rutgers. Nationally, the availability of academic jobs in the sciences and engineering relative to the number of new Ph.D.'s has declined, and there is an associated shift toward nonacademic jobs. Industry is increasingly interested in graduates with broad, but at the same time in-depth, knowledge and a demonstrated ability to conduct independent research. Growth in graduate education will require a broader educational experience for our graduate students and better relations with industry. A university-wide industry advisory board specifically dedicated to maintaining graduate program strength would be in a strong position to leverage funds and could provide the necessary leadership, and potentially financial support, to enhance opportunities for students in a wide range of programs at Rutgers.

Special Issues Affecting Centers, Bureaus, and Institutes (CBIs)

- CBIs and academic departments depend on interactions that are mutually beneficial. Mechanisms to promote good relationships include sharing overhead returns and royalty income from patents, establishment of joint committees, joint membership in graduate programs, involvement in undergraduate teaching, research programs, and curriculum development, and collaborative research.
- CBIs should undergo the standard process of academic review that is currently used for academic programs, but the charge to the reviewers should be modified to reflect issues that are unique to each CBI. CBIs should meet high standards, as assessed by measures such as amount of external funding, publications, quantity and quality of students, and faculty service.
- Those CBIs that have not pursued internships in industry should be encouraged to consider how such internships could serve their students. Similarly, CBIs should be encouraged to enhance research opportunities for undergraduates.
- CBIs are established to exploit unique opportunities, and they provide a jump start in a particular field or assist in collaboration beyond established boundaries of departments and institutions. Rutgers needs to be cautious in the establishment of new CBIs, but should proceed if missions, objectives, and budgets are agreed upon and clear, and if the proposed units fit in with the university's strategic planning efforts. CBIs should be disbanded if they cease to have a useful function, if they become redundant, or if the university's priorities shift.
- Assessments of quantitative outcomes to gauge progress should seek evidence of contributions beyond those of individual faculty. Measuring performance in meeting goals will lead to logical judgments of effectiveness.

Special Issues Affecting Professional Education

- Rutgers should support the development of Ph.D. studies in professional programs where justified by the research and teaching mission of the unit, but not in preference to professional programs where doctoral study is neither appropriate nor required.
- In promotion and tenure matters, care must be taken to understand the various ways in which scholarship of quality can be manifested in the professions, particularly where the ultimate decisions are centralized (as at Rutgers) and therefore not primarily in the hands of those who understand the profession best. Failure to do so inevitably undercuts the cause of quality itself,

- because promising young scholars will seek out institutions of at least equivalent reputation that they perceive to be more hospitable, even if perception outruns reality.
- Rutgers should encourage interdisciplinary work by ensuring strong arts and sciences programs on each campus in proximity to the appropriate professional schools, and by using distance learning and other advanced infrastructures to support scholarly exchanges as well as teaching.
 - With tight budgets an inevitability, weak or redundant programs must be carefully evaluated. Should it become necessary to reduce or eliminate strong programs solely for budgetary reasons, the impact should not be disproportionately felt by professional programs.
 - In addition to excellence in teaching and scholarship, excellence in public service should be recognized in evaluating professional programs, because of their unique contribution to discharging the university's overall commitment to public service.
 - External review is particularly important for professional schools, because of the close connections to the practice of the profession that are inherent in professional education and scholarship. The best defense against accreditation problems is to ensure that programs are not allowed to slide to the point where external review problems are predictable. With respect to resources, adequate year-to-year support is probably, in the long run, cheaper than major fixes after the problem has assumed larger proportions.
 - Undergraduate professional education is appropriate, provided that there is sufficient intellectual rigor in the program to prepare first-degree students with a breadth of knowledge and the capacity for critical thinking that is the hallmark of a liberal education. Where professional education is more appropriately concentrated in graduate programs, linkages between professional faculty and undergraduate teaching should be encouraged.

RUTGERS' PUBLIC COMMUNITY

Improved Communication with the Public

- Research and graduate education could make an even greater positive impact on society if communication among universities and local citizenry, state and national governments, and industry were improved. Ongoing research at Rutgers has the potential to improve the state's and the nation's elementary and high school education systems, environment, economy, and the health of its citizens. The Offices of University Communications and of Government Relations, key to our public relations efforts and in marketing noteworthy aspects of Rutgers to the greater community, should focus more effort on informing the larger community about Rutgers' exceptional programs, noteworthy research successes, and service to the community.
- Despite the importance of responsiveness to current and potential community service needs, Rutgers should focus on basic research and instruction with long-range outcomes rather than attempt to redirect research towards short-range outcomes for the sake of demonstrating public service.

Proliferation of Graduate Programs

- In order to provide excellence in its programs Rutgers must make hard choices about what it can truly and fairly support. Program proliferation throughout the U.S. has meant that overly

- specialized, narrowly focussed graduate programs are being marketed to potential students as “quick fixes” to employment concerns. The quality of the education offered, and the narrow focus of the materials covered, may contribute to vocational problems in the future and to a failure to truly educate the students. No one university can offer its students all possible combinations of educational specialization.
- As the state university, Rutgers must continue to be the premier graduate/professional education presence throughout all regions of New Jersey. This is an integral part of Rutgers’ tradition and mission. However, other institutions which have not had a tradition or mission in this area have begun to challenge Rutgers in the area of graduate and professional education. As these institutions become providers of graduate education they often cannot maintain the same standards, nor offer the same comprehensive services that can be offered by established programs. Program proliferation, especially among public institutions, inevitably means competition for scarce resources from state and local sources. By sharing a finite pot of public resources, these small programs divert scarce resources and may adversely affect programs that have taken many years to develop. The development and maintenance of doctoral programs should be encouraged at those institutions with the appropriate resources to provide excellent education, and discouraged at institutions that do not have sufficient and comprehensive resources. Rutgers should play a proactive role in making the case against program proliferation.

Increased Support for Research

- There is little doubt that consistent long-term support of basic scientific research is critical to sustaining the sources of the major breakthroughs in health care and technology that have improved and expanded human capacity and the quality of life. The challenge for us at this time is to persuade the government and the private sector that an increased investment in basic research is in all of our interests, and to encourage innovative partnerships among universities, government, and industry. And, as a comprehensive senior institution, Rutgers needs to consider how such funds will be distributed in the educational landscape. Given a rapidly expanding field of higher education providers, many without the resources to provide high quality programs, it is critical for those institutions of the highest quality to make the case that resources should follow excellence in graduate education. Rutgers needs to move ahead proactively in forging partnerships and alliances to support our institution.

Table 1
Trends in Graduate School Enrollment in the U. S. and at Rutgers by Major Field
1986-1995

Major Field	National		Rutgers	
	Total AY 1995	Cumulative Change 1986 - 1995	Total AY 1995	Cumulative Change 1986 - 1995
Arts and Humanities	94,927	34%	833	46%
Biological Sciences	59,153	10%	707	-9%
Engineering	94,439	10%	772	6%
Physical Sciences and Mathematics	88,136	0	987	18%
Social and Behavioral Sciences	98,934	22%	1093	20%
Total	435,589	16%	4,392	15%

Table 2
Trends in Rutgers University Graduate Applications/Admitted/Enrolled
1992 - 1996

	Applications % Change 1992 - 1996	Admitted % Change 1992 - 1996	Enrolled % Change 1992 - 1996
Arts & Humanities	-23%	-20%	-23%
Biological Sciences	-12%	-18%	-33%
Engineering	-24%	-24%	-37%
Physical Sciences & Mathematics	-27%	-24%	-32%
Social & Behavioral Sciences	-13%	-39%	-44%
TOTAL	-19%	-24%	-34%

Table 3
Trends in Rutgers University Graduate Degrees
Awarded by Major Field 1986 to 1996

	1986	1996	% Change 1986 - 1996
Master's Degrees			
Arts & Humanities	85	98	+15%
Biological Sciences	101	58	-43%
Engineering	139	135	- 3%
Physical Sciences & Mathematics	97	101	+ 4%
Social & Behavioral Sciences	94	112	+19%
Total	516	504	- 2%
All Disciplines (including professional schools)		2,056	
Ph.D. Degrees			
Arts & Humanities	18	55	+206%
Biological Sciences	71	64	-11%
Engineering	22	71	+223%
Physical Sciences & Mathematics	38	77	+103%
Social & Behavioral Sciences	56	66	+18%
Total	205	333	+ 62%
All Disciplines (including professional schools)		445	

Table 4
Rutgers, and Publics, and National
Median Time for Receiving Ph.D.*

	RUTGERS		AAU PUBLICS			NATIONAL		
	Median Time	Number of Programs	Mean of Median Time	Rank	Number of Schools	Mean of Median Time	Rank	Number of Schools
Arts and Humanities	13.15	8	11.16	27	29	12.28	103	147
Life Sciences	8.36	7	7.76	26	30	8.19	136	201
Engineering	7.93	6	7.63	20	28	7.92	89	142
Physical Sciences	8.92	5	7.99	25	30	8.19	159	195
Social and Behavioral Sciences	10.07	7	10.35	16	30	9.99	113	190

* Median time lapse from matriculating into Graduate School to receipt of Ph.D. in years.

Source: NRC's Research-Doctorate Programs in the United States, Continuity and Change, 1993.

Table 5
Self-Reported Time to Degree for Selected Disciplines at
Rutgers, New Brunswick

Discipline	Total Time to Degree (Years)	Discipline	Total Time to Degree (Years)
Animal Sciences	4.5	Spanish	7
Ecology & Evolution	6.2	Industrial & Systems Engg	5
Food Science	<5	Physics	<6.3
Pharmacology	5.5.-6	Statistics	<5
Plant Biology	4.5-5	Anthropology	7.4
Comparative Lit.	5-6	Communication, Info. LS	6.5
History	5-7	Economics	6
French	6	Geography	6.5
Music	5-7	Urban Planning	7
Philosophy	5-6		

Table 6
Rutgers University International Enrollment
by Major Field 1994-1995

	Undergraduate	Graduate	Total
Arts & Humanities	20	122	142
Biological Sciences	34	204	238
Engineering	136	375	511
Physical Sciences & Mathematics	44	353	397
Social & Behavioral Sciences	75	130	205
TOTAL	309	1,184	1,493

Table 7
Rutgers, and Publics, and National
Quality of Faculty

	RUTGERS		AAU PUBLICS			NATIONAL		
	Median Time	Number of Programs	Mean of Median Time	Rank	Number of Schools	Mean of Median Time	Rank	Number of Schools
Arts and Humanities	3.02	8	2.96	15	29	2.57	47	148
Life Sciences	3.38	7	3.34	16	30	2.63	45	204
Engineering	3.01	6	3.24	17	28	2.57	46	143
Physical Sciences	3.55	5	3.29	9	30	2.43	22	195
Social and Behavioral Sciences	3.27	7	3.24	14	30	2.38	34	197

Source: NRC's Research-Doctorate Programs in the United States, Continuity and Change, 1993.

Table 8
Trends in Rutgers University Tenure Track
Faculty Lines by Major Field 1986 - 1995

	New Brunswick		All Campuses	
	Fall 1986	Fall 1995	Fall 1986	Fall 1995
Arts & Humanities	198.98	176.46	269.72	238.46
Biological Sciences	81.39	76.68	89.89	85.68
Engineering	91.16	80.05	91.16	80.05
Physical Sciences & Mathematics	191.99	186.18	247.11	246.72
Social & Behavioral Sciences	186.11	178.58	279.69	294.48
TOTAL	749.63	697.95	977.57	945.39

Source: OIRAP; includes lines occupied by tenure track faculty at the rank of professor, associate professor and assistant professor, not including faculty on FASP.

Table 9
Total Number of Full Time Faculty at Rutgers by Rank*
1995 - 1996

	New Brunswick	Newark	Camden	Total
Professor	755	151	70	976
Associate Professor	522	129	86	737
Assistant Professor	364	100	53	517
TOTAL	1,164	380	209	2,230

*Includes the Arts & Humanities, Sciences and Engineering, and the Professional Schools
 Source: Rutgers Fact Book, 1995-96

Table 10
Rutgers University Graduate Financial Support
by Major Field 1995-1996

	State TA	State Fellowship	Federal GA	Total
Arts & Humanities	225	141	2	398 (25%)
Biological Sciences	102	32	113	247 (16%)
Engineering	86	35	125	246 (16%)
Physical Sciences & Mathematics	250	31	96	377 (24%)
Social & Behavioral Sciences	167	97	42	306 (19%)
TOTAL	860	336	378	1,574 (100%)

TA and GA support, Fall 1996 OIRAP, New Brunswick, Newark, and Camden
 Fellowship Support 1995-96 New Brunswick only; GSNB Accountability Report, 3/96

Table 11
1996-1997 Stipends for First Year teaching Assistantships at
Some Public AAU Universities

Note: Stipends are computed somewhat differently from university to university. For comparison with stipends at Rutgers, the stipends for first year TA at each university was calculated on a monthly and on a 10 month basis. All the universities listed provide tuition remission and all (except Illinois-Urbana-Champaign) pay for health insurance and hospitalization. Rutgers and the other universities that provide for stipends for 9-10 months generally have TA and Research Assistant (from faculty grants) appointments available during the summer. Some students receive fellowships, which are not compared in this table.

University	First Year Stipend (appointment)	Per Month	10 Months	Percent
Rutgers University	\$11,086 (10 months)	\$1,108.60	\$11,086	---
University of Michigan	\$13,020 (10 months)	\$1,302.00	\$13,020	17.4
Berkeley	\$16,565 (12 months)	\$1,380.40	\$13,804	24.5
UCLA	\$16,612 (12 months)	\$1,384.30	\$13,384	20.7
Indiana University	\$14,400 (12 months)	\$1,200.00	\$12,000	8.2
University of Illinois- UC	\$11,180 (9 months)	\$1,242.20	\$12,422	12.1
University of Minnesota	\$11,538 (9 months)	\$1,282.00	\$12,820	15.6
University of Wisconsin corrected	\$13,541 9167 (9 months)	\$1,504.60 \$1,018.60	\$15,046 \$10,186	35.7 -8.1
Pennsylvania State	\$15,120 (12 months)	\$1,260.00	\$12,600	13.7

Table 12
Rutgers, The State University of New Jersey
Research and Other Contracts and Grants (in Dollars)
Fiscal Years 1985/86 - 1995-96

Fiscal Year	Federal	State of New Jersey	Corporations	Foundations/ Other	Total
1985-86	28,240,115	14,745,559	6,139,249	3,778,570	52,903,493
1986-87	29,350,216	15,295,519	7,138,025	6,904,053	58,687,813
1987-88	31,657,086	21,180,181	8,996,198	5,213,983	67,047,448
1988-89	41,484,962	29,316,016	10,128,432	9,779,670	90,709,080
1989-90	46,059,810	22,876,757	10,508,923	13,364,888	92,810,378
1990-91	51,125,055	17,415,776	11,436,833	15,980,157	95,957,821
1991-92	70,826,955	17,377,134	13,175,844	14,842,059	116,221,992
1992-93	77,972,156	16,855,807	15,532,047	19,868,215	130,228,225
1993-94	93,395,283	24,446,601	11,119,324	20,450,561	149,411,769
1994-95	91,531,132	18,611,497	12,473,404	18,857,528	141,473,561
1995-96	90,948,104	22,484,031	13,604,043	21,009,114	148,045,292

Source: Office of Research and Sponsored Programs

Table 13
Rutgers, The State University of New Jersey
Industry Support (in Dollars)
Fiscal Years 1990/91 - 1995/96

Fiscal Year	Corporate Research Contracts	Corporate Grants-in-Aid	Non-contractual Gifts from Corporations	Licensing Income	Total
1990-91	6,916,697	4,520,136	11,160,028	1,557,232	24,154,093
1991-92	8,225,225	4,950,619	12,756,137	1,762,792	27,694,773
1992-93	11,095,007	4,437,040	12,817,664	1,886,616	30,236,327
1993-94	6,946,483	4,172,841	13,199,991	1,936,294	26,255,609
1994-95	8,329,225	4,144,179	13,095,455	2,389,547	27,958,406
1995-96	9,611,727	3,992,316	17,362,145	N/A	30,966,188

Source: Office of Research and Sponsored Programs

Table 14
Trends in Graduate Professional Enrollment at Rutgers
1992-1996

GRADUATE PROFESSIONAL PROGRAMS	1992	1993	1994	1995	1996	% Change 1992-1996
COLLEGE OF PHARMACY	36	36	49	69	87	141.7
E J BLOUSTEIN SCH OF PLANNING & PUBLIC POLICY *	--	48	83	85	102	112.5
PhD PROGRAM **	50	45	17	14	12	-73.3
ENGINEERING MASTERS & PhD PROGRAMS	249	256	180	163	158	-36.5
GRAD SCH OF APP & PROF PSYCHOLOGY	165	160	165	176	175	6.1
GRAD SCH OF EDUCATION	1247	1395	1531	1557	1486	19.2
GRAD SCH OF MANAGEMENT	1491	1409	1348	1546	1496	0.3
PhD PROGRAM	202	178	176	151	157	-22.3
MASON GROSS SCH OF THE ARTS	194	224	229	230	226	16.5
PUBLIC ADMINISTRATION - NEWARK	115	123	73	60	58	-49.6
PUBLIC POLICY & ADMINISTRATION - CAMDEN	52	44	52	24	26	-50.0
SCH OF BUSINESS - CAMDEN	195	176	171	178	171	-12.3
SCH OF COMM., INFORM. & LIBRARY STUDIES	487	499	538	468	488	0.2
PhD PROGRAM	24	20	19	18	16	-33.3
SCH OF CRIMINAL JUSTICE	47	66	82	77	76	61.7
PhD PROGRAM	26	27	11	16	17	-34.6
SCH OF LAW - CAMDEN	727	714	768	778	774	6.5
SCH OF LAW - NEWARK	805	770	802	796	787	-2.2
SCH OF MANAGEMENT & LABOR RELATIONS *	--	--	--	102	221	56.9
SCH OF SOCIAL WORK	1074	1021	1083	1107	1027	-4.4
PhD PROGRAM	8	10	4	7	5	-37.5
TOTAL	7194	7221	7381	7622	7565	5.2

* For schools that did not exist in 1992, percent changes are calculated from first year of enrollment.

** Includes enrollments for Urban Planning and Policy Development; enrollments for DPH and PhD in Public Health, offered jointly with UMDNJ, are not available.

APPENDIX 1

CENTERS, BUREAUS, AND INSTITUTES

<p>Accounting Research Center Advanced Biotechnology and Medicine, Center for (joint with UMDNJ) Advanced Food Technology, Center for Advanced Infrastructure Technology, Center for Agricultural Experiment Station, New Jersey Advanced Infrastructure Technology, Center for Alcohol Studies, Center of American Affordable Housing Institute American Woman and Politics, Center for the Biological Research, Bureau of Biomaterials and Medical Devices, Center for (joint with UMDNJ) Biomaterials Research, Rutgers Center for Biostatistics, Institute of Biotechnology Center for Agriculture and the Environment Camden Center for the Arts Camden Council on South Africa Cancer Research, Laboratory for Care for the Mentally Ill, Center for Research on Cellular and Molecular Biodynamics, Center for Ceramic Research, Center for Change in Urban Education, Center for Coastal and Environmental Studies, Center for Cognitive Science, Rutgers Center for Computational Design, Center for Computational Neuroscience, Center for Computer Aids for Industrial Productivity, Center for Computer Science Research, Laboratory for Controlled Drug-Delivery Research Center Controlled Environment Agriculture, Center for Council on State Constitutional Studies Crime Prevention Studies, Center for Criminological Research, Institute for</p>	<p>Critical Analysis of Contemporary Culture, Center for Demanufacturing, Center for Digital Signal Processing Center Discrete Mathematics and Theoretical Computer Science, Center for Eagleton Institute of Politics Economic Research, Bureau of Ecopolicy Center for Agriculture, Environmental, and Resource Issues Edison Papers, Thomas A. Educational Equity, Consortium for Electrical Engineering, Center for the History of Electronic Texts in the Humanities, Center for Employment Policy and Workforce Development, Center for Engineered Materials, Institute for Engineering Research, Bureau of Entrepreneurial Management, Center for Environmental and Agricultural Education, Center for Environmental and Occupational Health Sciences Institute Environmental Communication, Center for Environmental Protection, Rutgers Center for Ethnicity, Culture, and the Modern Experience, Institute for Excellence in Urban Education, Institute for Fiber Optic Materials Research Program Financial Services, Center for Research in Fisheries and Aquaculture Technology Extension Center Global Change and Governance, Center for Government Services, Center for Health, Health Care Policy and Aging Research Institute Hispanic Women Leadership Institute</p>
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Historical Analysis, Rutgers Center for
 Human Evolutionary Studies, Center for
 Hungarian Studies, Institute for
 Information Management, Integration and
 Connectivity
 Instructional Information Technologies, Ctr for
 Interfacial Molecular Science Laboratory
 International Business Education, Center for
 International Conflict Resolution and Peace
 Studies
 Internet Technology Institute
 Japonisme, International Center for
 Jazz Studies, Institute of
 Jewish Life, Center for the Study of
 Journalism Resources Institute
 Laboratory for Language and Cognition
 Latino Arts and Culture, Center for
 Local Democracy in Poland
 Management Development, Center for
 Management and Entrepreneurship, Center for
 Marine and Coastal Sciences, Institute for
 Materials Synthesis, Center for
 Mathematics Education Institute
 Mathematical Sciences Research, Center for
 Mathematics, Science & Computer Education,
 Center for
 Microelectronics Research Laboratory
 Molecular and Behavioral Neuroscience, Ctr for
 Molecular Biophysics and Biophysical
 Chemistry, Center for
 Multimodal Collaborative Systems, Center for
 Nanostructured Materials Research, Lab for
 National Transit Institute
 Negotiation and Conflict Resolution, Center for
 Newark Center for Families and Communities
 New Brunswick Center for Neuroscience
 New High Energy Theory, Center for
 New Jersey Small Business Development Center
 Operations Research, Rutgers Center for
 Packaging Engineering, Center for
 Paul Robeson Cultural Center
 Physics Research, Bureau of
 Policy Research, Forum for
 Project on Regional & Industrial Economics
 Public Interest Polling, Center for
 Public Productivity, National Center for
 Regulated Industries, Center for Research in
 Remote Sensing and Spatial Analysis, Grant F.
 Walton
 Russian, Central and East European Studies,
 Center for
 Small Business Development Center
 Social and Community Development,
 Center for Social Research and Instruction,
 Center for
 State Constitutional Studies, Council for
 Strategic Urban Community Leadership, Center
 for
 Study of the Global Workforce, Center for the
 Surface Modification, Laboratory for
 Systems and Control, Rutgers Center for
 Theoretical and Applied Genetics, Center for
 Transportation Policy Institute
 Trenton Academic Center
 Turfgrass Science, Center for
 Urban Policy Research, Center for
 Vision Research, Laboratory of
 Waksman Institute of Microbiology
 Walt Whitman Center for the Culture and
 Politics of Democracy
 Wireless Information Network Laboratory
 Women and Work, Center for
 Women, Institute for Research on
 Women s Global Leadership, Center for
 Women s Leadership, Institute for

June 1997

APPENDIX 2

LIST OF CBIs AND INDIVIDUALS CONSULTED FOR THIS REPORT

* subcommittee member

Center for Advanced Biotechnology and
Medicine: Dr. Aaron Shatkin

Center for Advanced Food Technology: Dr.
Josef Kokini

Center for Agricultural Molecular Biology
(AgBiotech): Dr. Peter Day*

Center for Alcohol Studies: Dr. Robert Pandina

Center for Biomaterials Research: Dr. Joachim
Kohn

Center for Discrete Mathematics and Theoretical
Computer Science: Dr. Fred Roberts

Center for Entrepreneurial Management: Dr.
Ivan Brick

Center for Global Change and Governance: Dr.
Richard Langhorne

Center for Molecular and Behavioral
Neuroscience: Dr. Ian Creese

Center for Molecular Biophysics and Biophysical
Chemistry: Dr. Wilma Olson*

College of Engineering: Dr. Ellis Dill

Department of Chemistry–New Brunswick: Dr.
Roger Jones

Department of Food Science–New Brunswick:
Dr. Paul Lachance

Department of Statistics–New Brunswick: Dr.
Yehuda Vardi

Eagleton Institute: Dr. Ruth Mandel

Environmental & Occupational Health Sciences
Institute - Dr. Bernard Goldstein

Fiber Optic Materials Research Program - Dr.
George Sigel

Institute of Biostatistics - Dr. Herbert Robbins

Institute for Health, Health Care Policy, and
Aging Research - Dr. David Mechanic

Institute for Marine and Coastal Sciences - Dr.
Frederick Grassle

Plant Science Department–New Brunswick - Dr.
Harry Janes

Waksman Institute - Dr. Joachim Messing

APPENDIX 3

ACCREDITED PROFESSIONAL SCHOOLS AND PROGRAMS

NEW BRUNSWICK CAMPUSES

College of Engineering
School of Education
School of Planning
School of Psychology
School of Social Work
School of Communication, Information and
Library Studies
School of Performing Arts (graduate
undergraduate)
School of Pharmacy (graduate and
undergraduate)

Programs in:

Art
Business
Dance
Engineering
 Bioresource
 Ceramic
 Chemical
 Civil
 Electrical
 Industrial
 Mechanical
Environmental/Agricultural Science
Landscape Architecture
Librarianship
Music
Pharmacy
Physician's Assistant
Psychology
Public Health
Studio Arts
Social Work
Teacher Education
Theater

NEWARK CAMPUS

School of Law
School of Criminal Justice
School of Management (graduate and
undergraduate)
College of Nursing (graduate and undergraduate)

Programs in:

Business
Law
Music
Nursing
Social Work
Teacher Education

CAMDEN CAMPUS

School of Business (graduate and undergraduate)
School of Law

Programs in:

Law
Nursing
Physical Therapy (cooperative program with
UMDNJ)
Public Policy
Social Work
Teacher Education