

Executive Summary of the 2003 Merrill Publication

Recruiting and Training Future Scientists: How Policy Shapes the Mission of Graduate Education

KEYNOTE ADDRESS – Day 1

Debra Stewart

President, Council of Graduate Schools

- Graduate education is one of the United States' most successful enterprises, and it is growing. More than 220,000 international graduate students enrolled in U.S. programs. Graduate education enjoys strong support because the research enterprise contributes to the economy.
- The Council of Graduate Schools directed the "Preparing Future Faculty" initiative as early as 1993, and other national reform studies have followed. These include: the Carnegie Initiative on the Doctorate, the Re-envisioning the Ph.D. program, the Responsive Ph.D. Project and the Sloan Professional Science Master's program.
- Studies of doctoral education show a dissatisfaction by students with 4 areas: breadth of the curriculum and opportunities for interdisciplinary study; information about the process and outcomes of study before they begin their educational programs; attention to job skills that will be required; career guidance and job placement (including non-academic jobs).
- Assessment has always been critical to the success of graduate education. Interdisciplinary programs are important for the student's learning experience and for research, but we have not yet devised effective ways to describe and compare these programs when making awards in an assessment-based competition.
- State universities are experiencing some of the most dramatic budget cuts in decades and this inevitably has an impact on state-supported teaching and research assistantships for graduate students.
- To increase the likelihood that our graduate students will complete their degrees, reform-based research tells us: certain combinations of funding are better than others; placing time limits on support encourages graduation; women benefit from being research assistants; participation in the academic life of a department is important and funding mechanisms can encourage this. What we know can be built into the federal support programs for graduate students—but will this bind the faculty PI's in a way that damages the effectiveness of the targeted research project?

- Graduate education in the U.S. is dependent on international students—particularly in the fields of engineering, computer science, math and economics. The policies enacted in the wake of 9/11 will inevitably slow the flow of foreign talent to the U.S. The United States must develop a robust domestic talent pool for doctoral study in science and engineering, or it will approach a national crisis in education.
- The recent U.S. Supreme Court decision on Michigan has engendered a good discussion about how America can prepare effective pathways to graduate school for historically disadvantaged groups in order to meet its future workforce needs. We must redouble our efforts to expand graduate preparation in the U.S.—and we must graduate those whom we admit to our programs.

KEYNOTE ADDRESS – Day 2

Martha Crago

President, Canadian Association of Graduate Studies and Dean of Graduate and Postdoctoral Studies, McGill University

- The Canada Graduate Scholarships were created in 2003 to meet the federal government's goal of moving Canada from 15th to 5th in the world in research and development. These scholarships provide \$35,000/year to doctoral students for 3 years and \$17,500 to master's research students for one year. In Quebec, the government grants full tax exemption on all merit-based graduate scholarships. This situation is putting pressure on faculty to increase the amount of postdoctoral fellowships (from their own grants) because graduate students are now funded at a comparable level.
- The top research intensive universities in Canada investigated the actual times to degree and graduation rates of their students in graduate school and found that the minimum rates in the humanities and social sciences were alarmingly low. Median times to completion were also higher in the humanities and social sciences than in physical and life sciences. We also investigated the patterns of withdrawal from graduate study. Some students appeared to run out of steam or money after as many as 8 or more years of studying—this is an educational tragedy.
- Studies about how to retain graduate students leave us with opportunities for reform: if we know that participation in a group is important, then funding agencies should investigate the impact of graduate student funding mechanisms such as training grants, that support involvement of students with others. Mechanisms for setting objectives and tracking progress to degree should be transparent and widely used. Students should be counseled by advisors and administrators to withdraw earlier rather than later if they are ill suited to research and scholarship. Universities should consider failing students for documented lack of research progress.

- Students want more in the way of professional skill training. This could include: learning to present their research to various audiences; learning to write grants; learning about the full-range of employment possibilities; preparing a curriculum vita; and practice interviewing for a job.
- Students want to know more about their intellectual property rights. This includes: the meaning of the copyright on their thesis, marketing and proprietorship of a patent, and authorship of a journal article. Because universities increasingly have non-university partners in research, students need guidebooks to explain their universities' intellectual property policy as it relates to graduate students. They need to know whether they can share their findings with others in publications and seminars. Should they be paid by their supervisors' spin-off companies? Can students use equipment in their supervisors' spin off company? And universities should offer courses to graduate students in the responsible conduct of research and professional ethics.
- There are many unresolved issues in the postdoctoral experience: Do we need postdoctoral administrative offices? Should postdocs be paid a salary or a fellowship? Should they receive benefits? Should they have to obtain a certain score on a TOEFL test of language skills? Quebec has set a legal precedent defining the postdoctoral experience as a research internship, not an employment category.

IS ACADEMIC RESEARCH SUSTAINABLE?

Robert E. Barnhill

President, Center for Research, University of Kansas

- Federal support of research is under pressure because of tax cuts, the poor economy and more focus on post-9/11 issues. Because the federal government tends to under-fund its mandates, no university recovers the actual cost of federally funded research.
- African Americans, American Indians and Hispanics are under-represented in our science and engineering programs. We need leadership to develop this talent pool.
- State support of public universities is declining and will not proportionally increase after and if the economy improves.
- We must make the case for the economic benefits of university research. In Kansas, we generate 42 jobs per \$1 million of investment in university research and development. KU's research produced over 10,000 jobs in fiscal year 2002 according to AAU estimates.
- If the promotion and tenure committees do not reward interdisciplinary research, then a university will not do as well nationally as it could. Big-time research occurs in interdisciplinary teams. Research centers have been important in KU's institutional success.
- KU achieved a 28% increase in federal funds between 1996 and 2001, with the Lawrence campus seeing a 44% increase in this market share.

- A nationally agreed-upon benchmark for return on investment in academic research is 4:1 – one internal dollar should produce four external dollars. At the KU Center for Research, we calculate return on investment at our research centers by dividing research expenditures or indirect cost return by the total center investment (budget allocation plus returned overhead). For the humanities, we developed qualitative performance measures that involve the number of prestigious awards.

FIRST PANEL OF RESEARCHERS

Dan Monaghan, Professor of Pharmacology, University of Nebraska Medical Center

Janice Buss, Professor and Director of the Molecular, Cellular and Developmental Biology Graduate Program at Iowa State University

John Colombo, Professor of Psychology and Associate Dean of the Graduate School, University of Kansas

- Many students do not understand the demands of graduate school or postdoctoral training. It is important to help prospective students know what will be expected in terms of workload, time to degree, and the job market for Ph.D.'s. If the selection process were more careful, there might be less attrition in graduate school.
- Interdisciplinary programs are attractive to high caliber students. Faculty join interdisciplinary programs often because this gives them access to excellent students. Students like to be on the leading edge of research discoveries.
- To have strong interdisciplinary programs and recruit good students, we must invest. These programs are not typically part of the regular budgeting process that focuses on undergraduate education and is administered through departmental and college channels. Interdisciplinary students should not always be last on the list when allocating teaching assistantships or emergency funding. Tuition waivers, as well as stipends, are attractive.
- Most faculty believe that graduate education—especially doctoral education—is central to the mission of the research university. The interplay of research and graduate education is a reciprocal and transactional process: when an institution brings in visible and well-funded researchers, this attracts good graduate students which in turn makes the institution more desirable to faculty candidates, which will enhance the reputation of the graduate program.
- Traditional doctoral education is at risk today because it is considered inefficient and costly in terms of resources. We must address two problems: attrition and time to degree in order to improve efficiency and increase the research productivity of students and faculty.
- Rather than be more selective in admissions as a way to decrease attrition, we should improve our administration and advising. For example, we should set reasonable time limits for completion of the degree and

establish a probationary period once a student is admitted. Faculty advisors should make expectations explicit. Mentors should integrate new students into existing lines of research by, for example, suggesting that the student take on a programmatic extension of the faculty member's own work—this has a high probability of providing real research credential and the student can seek more independent contributions later in the graduate career. The faculty can also foster a culture where research products are generated in a timely manner.

PANEL OF RESEARCH/GRADUATE ADMINISTRATORS

R.W. Trewyn, Vice Provost for Research and Dean of the Graduate School,
Kansas State University

Jim Coleman, Vice Provost for Research, University of Missouri – Columbia

Ellen Weissinger, Executive Associate Dean of Graduate Studies, University of
Nebraska – Lincoln

- Recruiting science students with an interest in entrepreneurship is made possible by the programs for commercialization of intellectual property at Kansas State University. Students can experience the full range of intellectual property services and commercialization practices from academic theory to real world applications. As part of the MBA Technology Entrepreneurship track, graduate interns get practical experience in technology transfer. The intern program is being expanded to include students from various science and engineering disciplines.
- The KSU Research Foundation facilitates technology transfer by licensing intellectual property to major corporations and to local start-up companies. The Mid-America Commercialization Corporation (MACC) promotes technology-based economic development in the region and works with the KSU Research Foundation on commercialization activities. MACC manages a seed capital investment fund, which can infuse early stage funding into new start-up ventures; KTEC, the City of Manhattan and the KSU Foundation are investors in this fund, and share in returns on the investments.
- The new focus on the economic benefit of research has permeated almost every aspect of research on campus. Has the focus placed on research growth overshadowed the central role of discovery, creation, innovation and scholarship in the academy? If state legislators tie support for state universities to “economic outcomes,” what happens to the sustainability of graduate education if we don't deliver in clearly measurable ways?
- Identifying key areas of research investment is part of the strategic planning process for each university. If our plans focus on economic development, will we diminish the full range of graduate programs and alienate some of our key areas of academic excellence, such as the humanities?

- When we partner with the private sector in our research, we must deliver on time and within budget. This makes hiring research faculty, technical staff and postdocs more attractive than training graduate students. What effect will this have on graduate education?
- The Carnegie Initiative on the Doctorate (CID) is a multi-year research and action project to support efforts to more purposefully structure doctoral education in six core disciplines. The Department of Mathematics at the University of Nebraska – Lincoln was selected to participate in the CID. These are some of the questions the math department will answer: Is a curriculum emphasizing broad knowledge of mainstream math still appropriate? What revisions of our curriculum and degree requirements are necessary to accommodate interdisciplinary research? How do we best prepare Ph.D. students for jobs? How can we increase recruitment and retention of underrepresented minorities? The University of Nebraska – Lincoln is attempting to institutionalize this reform project by extending the practices to other departments.

PANEL OF GRADUATE SCHOOL ADMINISTRATORS

Suzanne Ortega, Vice Provost for Advanced Studies and Dean of the Graduate School, University of Missouri – Columbia

John E. Mayfield, Associate Dean of the Graduate College, Iowa State University

- The National Science Foundation now has a “broader impact” criterion within the graduate predoctoral fellowship awards process, which includes contributions to diversity and social benefit. Because fellowship panels are given little clear-cut advice on how to evaluate and give weight to the “broader impacts” criterion, however, the process breaks down. The criterion for advancing diversity becomes in effect a secondary selection factor, used only after the traditional intellectual merit criteria are fully and equally satisfied.
- At the University of Missouri – Columbia the directors of our graduate programs have agreed that diversity should be included as one of the 3-5 core indicators we use institution-wide to evaluate program quality and make related resource decisions. This will effectively close the gap between policies and programs by making diversity a key part of the admissions process and institutionalizing access and diversity as core principles.
- In the next 10 years, if trends continue, Iowa State University may enroll more than 1/3 of all its graduate students in interdepartmental programs.
- To justify new faculty positions, the Provost of Iowa State in 2003 included interdepartmental program need as one of the three grounds that could be used. This was unprecedented. Three of the eight positions approved were interdisciplinary. If this were to become a standard operating procedure for new hires, this one policy change could have a major impact

on the quality of education delivered by interdepartmental graduate programs.

SECOND PANEL OF RESEARCHERS / MENTORS

Jeffrey P. Katz, The Payless ShoeSource Professor of Business and Director,
Center for Leadership, Kansas State University

Diandra Leslie-Pelecky, Associate Professor of Physics, University of Nebraska –
Lincoln

Kim A. Wilcox, Professor, Department of Speech-Language-Hearing and Dean of
the College of Liberal Arts and Sciences, University of Kansas

- Science and business are enjoying a renewed period of integration unmatched since the GI Bill redefined post-secondary education. The human genome project is an example of the way business can accelerate achievement in the public sector. Because the publicly funded International Human Genome Project competed with the commercial enterprise Celera Genomics in a race to map the genome, the basic research model changed to a time-dependent and outcome-focused activity with specific strategic goals. Scientists in the public sector realized that the achievement of their mission—public access to the research results—would occur only if they became business-savvy.
- As the number of commercial enterprises with academic links continue to grow, we must resolve these policy issues: developing appropriate university support services to assist in innovation value creation; training scientists, engineers and business students for commercial success in the world of innovation advancement; changing the risk/reward philosophy and alignment mechanisms in the university-industry environment; and seeking to balance the capitalization of the research enterprise.
- NSF now requires education and outreach in successful grant proposals—part of the “broader impact” requirement. Most faculty members have no training to implement effective education/outreach programs. Graduate students will eventually have to fulfill these NSF objectives when they take jobs in academia, so they should be prepared.
- The University of Nebraska was awarded an NSF GK-12 grant for training graduate students from the fields of science, math and engineering to be resources in the K-12 schools. The Graduate Fellows spend 8 hours/week in the schools and 2 hours/week planning with teachers in return for a stipend of \$27,500/year plus a \$10,500 cost of education allowance. The institutional effects UNL has experienced include: improving cooperation between the College of Arts and Sciences and the College of Education and Human Sciences; and increased faculty interest in teacher education. The graduate students believe it has improved their ability to work and communicate with people from diverse backgrounds.
- The American Speech-Language-Hearing Association (ASHA) was one of the first fields to require advanced training as a prerequisite to clinical

- certification. At the time, this was a high standard and has been successful in assuring the best possible clinical services for the public; however, this decision set in motion a trajectory that put the entire discipline at risk. In 1951, the majority of ASHA's members were academicians interested in the study of communication processes and disorders, but by 2003, the vast majority of ASHA's members are clinical professionals who hold a terminal master's degree. At the undergraduate and master's degree level, the curriculum is now geared toward preparing individuals to be service providers. The effect is that students pursuing a research career must essentially start over after the initial 6 years because they have not yet acquired the specific knowledge and scientific skills necessary for a doctoral education. Also, by formulating the curriculum around the master's degree, the field is attracting students who have little or no interest in science; they are drawn instead to a respected professional field with guaranteed employment and a good salary, which can be achieved with a master's degree.
- It is important to maintain a balance between the discipline and the profession of a field. With Communication Sciences and Disorders, the demand for trained professionals grew so rapidly that societal pressures overwhelmed longer-term scientific needs. Today, the leadership in the field is increasingly influenced by and drawn from the professions and so, at the highest levels, it is difficult to exert the influence necessary to maintain balance and to retain an academic focus.

REACTION AND CONFERENCE SUMMARY

Martha Crago, President, Canadian Association of Graduate Studies

- As universities, we need to understand ourselves better. We need to collect the same high quality data about our institutions, and analyze it, as we would do in our own disciplinary research endeavors. We can capture our transformations in facts. This can awaken us to our own local realities because it is not always easy to get the facts straight.
- Universities need to be strategic in difficult economic times—leverage funds and become enterprising. At this conference, we heard about several examples: partnering with the private sector; marketing goods produced on campus; encouraging granting agencies to increase funding to graduate students; and using lab space in the private sector for graduate students. Another technique we've used at McGill is to allocate operating funds to programs that are already successful in attracting external fellowship money for students; this reminds the community that the university must leverage external money.
- I've been told that some of the most important discoveries in science have happened by accident. It is important to preserve the university as a place where playful experimentation and free thought continue to exist. We are

- likely to lose something if goal-oriented research is the only research we do. It's a question of balance.
- Our students, researchers and university administrators need to develop the kind of skills that will allow them to communicate about their work to a wider range of people. In this way more people can appreciate the work of scientists and scholars, and more children will want to become them.
 - When we ask ourselves why it has been a goal to attract international graduate students, we must realize that it began as a sort of colonialism. If our aim was to educate students so they might return to their home countries and build their own higher education networks, it should be a cause of joy that graduate education in other countries is now a success—not a cause of jealousy. Education is a kind of spark that we pass on to others. Today, we should go on educating international students because for one thing they provide us with diversity at a time when we need it most. We should take the opportunity to learn from them—to educate our North American students about the world.
 - In the wake of 9/11, we must think seriously about the role our universities can play in the interest of global well-being. McGill has a Middle East Peace Building Programs that brings students from Palestine, Jordan and Israel together to obtain a Master's of Social Work. Their time at McGill provides them with a safe haven to explore their commonalities and differences and to get to know each other as human beings, not just political foes. Higher education is an agent of change that develops human capacity, knowledge, and understanding.

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Reprinted from the white paper:

Rice, M.L. (Ed.). (2003). *Recruiting and Training Future Scientists: How Policy Shapes the Mission of Graduate Education*. (MASC Report No. 107). Lawrence, Kansas: University of Kansas Merrill Advanced Studies Center.