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*Mission statements of American research universities typically embrace three areas of faculty activity: teaching, research, and public service. Yet, in most of these institutions, the emphasis is primarily on research, and this is reflected, as well, in the faculty reward system. This article develops a historical perspective for the status quo, calls for self-examination and reaffirmation of the tripartite mission, and concludes with some recommendations for change, both at the level of the institution and the federal government. These include a greater emphasis on diversity, not only with regard to individuals but also in terms of institutional mission. Mission diversity is of particular importance among the nation's two hundred engineering doctoral institutions.*

# Publish and Perish

## *Research Universities in the 1990s*

The mission statements of research universities in the United States typically embrace three areas of faculty activity: teaching, research, and public service. Consequently, it follows that the criteria for evaluation and reward of faculty performance should cover the same areas of activity. What has this to do with the quality of undergraduate science and engineering education? My response is: "everything." Evaluation and reward of performance are strongly coupled to the improvement of undergraduate education. In what follows I will briefly develop a historical perspective for examining the contemporary research university to place the so-called "teaching vs. research" issue in a context that suggests courses of action. I will conclude with some recommendations for change, both at the level of the institution and the federal government.

Some thirty-five years ago I recall a meeting of the faculty of the College of Engineering at Berkeley at which we discussed the following proposition: "Should graduate students who were employed on research projects, and therefore paid a salary, be allowed to use the results of their research in fulfillment of the requirements for the thesis or dissertation?"

This question speaks of another era that contrasts with the academic world today and sets a context for my remarks. Among the some 3,000 institutions of higher learning in this country, American research universities have achieved undisputed success in research, service, and provision of mass education.

Notwithstanding this success, they have, in my view, acquired symptoms that are brought to mind by the following quotations:

“The institutionizing on a large scale of any natural combination of need and motive always tends to run into technicality and to develop a tyrannical Machine with unforeseen powers of exclusion and corruption.”

(From a 1903 essay on the Ph.D. by William James.)

“Practices that begin by filling needs become detached from their original purposes, even counterproductive to them. Having been adopted on a large scale, however, these practices take on a power of their own. We place expectations on college and university faculty members that discourage them from devoting time to students and the classroom. Tyrannical machines dominate American education.”

(From Lynne V. Cheney’s National Endowment for the Humanities Report, 1990.)

Whether or not tyrannical machines dominate, or simply skew the missions of research universities, there are such machines among us. Let me cite examples of some of the products of these machines.

I quote a Stanford faculty member at a panel discussion on integrating teaching, research, and community service (as reported in the *Stanford Magazine*, Dec. 1991):

“Faculty don’t talk to each other about their public service. It doesn’t count. It smacks too much of applied research—that’s the kiss of death.”

The National Science Foundation convened a colloquium of fifty-three Presidential Young Investigators to consider engineering, mathematics, and science education for the year 2010 and beyond. Their report, entitled “America’s Academic Future,” includes the following statement:

“The tenure, promotion, and reward system is our greatest barrier to a better future. Tenure guidelines uniformly denote that teaching, research, and service are the criteria for tenure. It is our experience, however, that the road to tenure is marked research, research, research.”

I am sure that every reader of this article can add to this list of quotations.

A survey of nine hundred faculty members at five of the nine University of California campuses found that although 38 percent feel that research interferes with teaching, 92 percent feel that research is a very high priority. Further, 97 percent rate being a teacher as very important, but only 7 percent stated that UC faculty are rewarded for good teaching.

How do other faculties of American research universities feel about the milieu in which they carry out their work? Not very good, according to the 1989 Faculty Survey conducted by Ernest Boyer for the Carnegie Foundation for the Advancement of Teaching. In this survey, 69 percent of faculty respondents at research universities agreed with the statement,

"At my institution we need better ways, besides publications, to evaluate the scholarly performance of faculty." Furthermore, the survey calls attention to disturbing age-related concerns: 53 percent of those under forty years of age reported that, "...my job is the source of considerable personal strain...", 53 percent agreed that they hardly ever have time to give a piece of work the attention it deserves, and finally, 43 percent of those under forty agreed that, "The pressure to publish reduces the quality of teaching at my university."

How did this happen and what can be done about the tyrannical machine? Should anything be done about it? I will address the last question first, and then turn to a discussion of the first two questions.

The choice of the title "Publish and Perish" suggests my response to the question. We have heard from administrators, faculty, students, political officials, and the public. I need not dwell further on the credibility of research universities in our society in 1992. Self-examination and reaffirmation of our tripartite mission, together with a commitment to a faculty reward system that supports the broad mission, are self-evident steps that must be taken.

## A Historical Perspective

The evolution of the mission of American universities has reflected important societal needs at critical times. The clear focus of the early colonial colleges was on the intellectual and moral development of a (male) student body, which would in turn contribute to the public good. Indeed, the newly appointed President of Harvard College, Charles Elliot, declared in 1869 that "the prime business of American professors...must be regular and assiduous class teaching." Note that the term "research" does not yet appear in the mission statement.

The Morrill Act of 1862 and the Hatch Act of 1887 provided unprecedented opportunities for states to develop a new kind of public institution that would support both education in the liberal arts as well as mechanical arts and agriculture. The dimension of productive service was added to the mission of public as well as private universities and their faculties. A dramatic change in the mission of American universities occurred during World War II as a result of the federal government turning to academia to create a partnership needed to pursue the war effort. Following that war, the establishment of the National Science Foundation and the expansion of support for research and graduate education by federal mission agencies set the stage for the shifting of the allegiance of faculty toward discipline and department instead of school and institution. Emphasis was increasingly placed upon pure research unencumbered by social determination or utility. At the same time, however, the question of access to higher education was being redefined and institutions were being moved from an *elitist* to a *universal access* system of higher education. The civil rights movement and consequent legislation added the elements of affirmative action and a commitment to diversity to the interpretation of the mission of universities and the work of faculty.

## The Research University and the Nation

The national environment constitutes a sphere of influence on the affairs of universities that is profound. Just as the federal government turned to the universities during World War II to create teams to ensure survival of the nation, so are we (particularly schools of engineering) being mobilized once again, though with less clear an objective, to assist in waging the economic war of global competitiveness and economic survival. Federal agencies have exerted substantial influence over both the content as well as the style of research and service activities in which universities are invited to participate. The use of the word "invited" is a euphemism, for it is demonstrably impossible for a research university, whether public or private, to survive today without federal support.

As noted in the historical overview, this state of affairs began with the Morrill Act and evolved after World War II, when the National Science Foundation was created and federal mission agencies became involved in the support of graduate education in the United States in a large way. Lest I might be misunderstood, I do not deplore this situation; indeed, it has produced the best university system in the world—witness its popularity

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among foreign graduate students, even if relatively unappreciated by our own domestic science and engineering students. What I wish to observe is that there has been an unmistakable, and probably irreversible, intervention of the federal government into the affairs of our universities. There is no ivory tower, if there ever was one.

A major impact that affects all faculty has been the pressure to become a productive scholar in the sense of discoverer and reporter of new knowledge. Sources of this pressure are funding agencies, publishers of journals, universities themselves, and faculty qua faculty. A vicious circle has been created. Funding agencies are dependent upon their ability to define and secure resources to launch "new program initiatives." Faculty respondents to such programs build their cases before their peers, who make value judgments largely based upon evidence of intellectual capacity reflected in published papers. Publishers of journals, motivated by economics and prestige, are constantly seeking editors for new journals, which in turn require new manuscripts. Furthermore, research universities, and in increasing numbers institutions that aspire to become research universities, frequently expect or require their faculty members to offset academic-year salary in part from extramural sources, i.e., substitute research for teaching.

This impact does not only affect the conduct of research. A direct concomitant has been the shift in faculty loyalty and allegiance toward geographically dispersed, discipline-defined peers and away from college or school and home institution. This phenomenon was quantified in the 1989 Carnegie Foundation Survey in which it was found that 75% of the faculty at research institutions rated the sense of community at their institutions as fair or poor. In a real sense, disciplinary power has diminished

commitment to an institution, as researchers look horizontally for recognition, impact, and stimulation. In turn, universities have contributed to the process by emphasizing peer evaluation and departmental rankings. National rankings based upon media surveys have also added to the problem.

## Diversity in Colleges and Universities

In three years, the states of California and Texas will have public high school graduating classes in which so-called minority groups of students will be in the majority. An increasing number of states will join this group by the turn of the century. Words found in a letter to academic institutions from the presidential advisory board of the Ford Foundation express the importance of this fact:

"The task for us now is to fulfill our commitment to diversity by affirming its role in the educational purpose of our institutions, and by translating this affirmation into practice. To do this makes educational as well as moral sense. However impressive the particular skills and knowledge it imparts, undergraduate education aims broadly to increase students' capacity to lead productive and responsible lives. The pace of change in our world requires open-mindedness; the growing diversity of the population and the globalization of knowledge and economies leave little scope for those who are parochial minded and intolerant. Building the capacity to accept and thrive upon intellectual and human diversity is one of the most important contributions a college can make to its students' development.

"This conviction takes one beyond admission goals, orientation activities, housing policies, and even response to individual acts of intolerance or discrimination, important though all these are. It suggests that diversity ought to be woven into the academic life and purpose of the institution: valued by faculty, expressed through curriculum, sustained and nourished through cultural expression and extracurricular life. Moreover, a diversity of opinions must be protected against even the best intentioned constraints. Our world is pluralistic, and education cannot responsibly turn its back upon that reality."

We can no longer afford to view diversity as marginal activity. We cannot afford to think that achieving diversity in our institutions can be accomplished by a process of assimilation into an existing stable, institutional structure. What we badly need, in my view, is the will to examine, design, and implement necessary structural changes in our institutions.

Just as the Morrill Act served as a catalyst to develop the natural resources of our nation in its quest for industrialization, so now must we in academe concentrate on the development of human resources of unprecedented diversity in our quest for leadership and economic growth in the information age or postindustrial society, whichever term one uses to describe the future.

A significant additional dimension of diversity has to do not with people but with institutions and their missions. Here again there is need for careful examination of structure and purpose, avoiding marginalization. The 328 institutions offering engineering programs in this country should be encouraged to explore new directions and find new roles in the engineering educational system. *Mission diversity* is urgently needed in our engineering schools today. We need new role models to complement the so-called "research university" model. The nearly two hundred engineering doctoral institutions, with minor exceptions, are all aspiring to become a top-twenty research institution. In a paper in *Change* entitled "The New Race to be Harvard or Berkeley or Stanford," Clark Kerr noted the following:

"All 2,400 'specialized' institutions of higher education in the United States aspire to higher things.... These aspirations grow not only out of internal desires but also out of the expectations of members of their communities—their alumni, their states, their related industries and professions."

A consequence of this kind of race is discussed in a recent paper of Robert White, president of the National Engineering Academy. Writing in *The Bridge*, he called attention to the mismatch in resources available, and institutions and investigators vying for these resources. In his view, which I share, there is an overemphasis on the production of engineering researchers, who increasingly must compete for very limited resources, at the expense of engineers advancing the state of professional practice, especially manufacturing. Similar conclusions may be drawn for other fields as well.

### **Recommendations to Strengthen Undergraduate Education in Science and Engineering**

It is the view of many faculty, and I strongly share that view, that a central problem in the evaluation and reward of faculty performance is the overly narrow view taken in assessing intellectual attainment and creativity. Ernest Boyer, in *Scholarship Reconsidered*, urges that we move beyond the "teaching versus research" argument and examine the quality of scholarship, assessed over four activity areas. He suggests that the work of the professoriate be comprised of four separate, yet overlapping functions. These are:

- Scholarship of discovery
- Scholarship of integration
- Scholarship of application
- Scholarship of teaching

The term *scholarship of discovery* is typically equated to research. The search for new knowledge will unquestionably remain at the core of the mission of a research university. Yet, Boyer contends:

“There is need for scholars to work at making connections across the disciplines, placing specialties in larger context, illuminating data in a revealing way, often educating nonspecialists, too.”

This, he calls scholarship of integration.

*Scholarship of application* is embodied in the work of faculty members that flows directly from their professional knowledge. It may be, but is not limited to, the innovative practice of a profession; it may be the application of knowledge to a consequential social problem. In every instance, the same measures of accountability, as applied to the scholarship of discovery, are required.

The *scholarship of teaching* moves well beyond the commonly accepted notion of the teacher as a classroom performer, or as a tutor of a single individual, for the mere transmission of knowledge. Teaching incorporates these activities but is concerned more broadly with the synthesis and extension of knowledge, i.e., the transformation of knowledge. It is self-evident that much of what constitutes the scholarship of teaching goes on outside the classroom or student-faculty conference.

The faculty of all institutions of higher learning share, or should share, the responsibility for the synthesis, application, and transmission of knowledge, i.e., the scholarship of integration, application, and teaching. The scholarship of discovery is properly focused, though not exclusively, in research universities. Efforts that encourage the former categories of scholarship are most likely to improve the quality of undergraduate education. Efforts that encourage the scholarship of discovery are less likely to do so, although there can be exceptions. The reasons behind these assertions are clear and unassailable: institutional economic survival and prestige, as well as faculty prestige and honors, are directly related to the scholarship of discovery and are virtually disconnected from the other categories of faculty activity.

The value system currently in place in research universities is a product of both internal and external influences and pressures. The response of faculty, in my view, is both prudent and necessary for survival. Faculty are not the problem. Indeed, national surveys have made it clear that the majority of faculty in our research universities are not satisfied with the current value system for judging faculty performance—one that is strongly biased in favor of scholarship of discovery, or research.

Federal funding policies are strongly coupled to the value system currently in place in our research universities. In particular, the National Science Foundation has already taken the lead in demonstrating how to change the culture in our institutions. For example, the Engineering Research Center Program placed emphasis on scholarship of integration and application. The Undergraduate Engineering Coalition Program emphasized both the diversity issue and the scholarship of teaching. The Directorate for Education and Human Resources is increasingly engaging university faculty to utilize their expertise and resources to improve the quality of undergraduate education and, equally important, K-12 mathematics and science education. In short, faculty in research universities are being encouraged to engage in scholarly activities aimed at improving instruction in mathematics, science, and engineering.

What response can be expected from our universities? I am persuaded that there are both interest and commitment among university faculty to make needed adjustments in allocation of effort among teaching, research, and service. There is a strong desire for a cultural change that places greater emphasis on coherence and integration of subject matter in undergraduate education—outcomes that will flow from the scholarship of integration and of teaching. Such change will be greatly aided if federal agencies follow the lead of the National Science Foundation and broaden the base of funding for universities to embrace the full range of scholarly activity; simple economics will dictate the response. As noted in the National Science Foundation report previously cited, "America's Academic Future," federal, state, and other agencies that fund and evaluate education must undergo as much of a change in culture as that of academe.

Before the question of "What will happen to the level of effort in scholarship of discovery?" is raised, let me respond. I hope and I expect that it will ease off, and I cannot consider this to be anything but a good thing for research universities and our nation, not to mention undergraduate students. There is no basis for continuing to force all of our faculty into the mold of discoverer and reporter of new knowledge—there is neither the need nor the resources to make this possible at the rate at which it has been accelerating during the past few decades.

What is needed is the encouragement of a full range of scholarly activities supported by federal and state agencies, together with appropriate evaluation and reward within our institutions.

Restoration of balance among the activities of faculty, as well as flexibility in permitting a range of career paths, must be the hallmark of the faculty reward system. Achieving balance at the level of the department, college, or school—rather than in individual faculty—should inform institutional policy.

## University of California Task Force Recommendations

In conclusion, I would like to add to the above suggestions the principal recommendations of the University of California Task Force on the Faculty Reward System. At the time of writing, this report is still under discussion on the nine campuses of the university. Implementation of the report, whether in part or otherwise, will depend upon the action of the president of the university.\*

1. While teaching has remained prominent in the formal statement of the criteria (for appointment and promotion), the proper evaluation of and reward for superior intellectual attainment in the realm of teaching...has been slighted. Documentation and evaluation of meritorious achievement in teaching requires a level of faculty

\*On July 15, 1992, the president of the University of California issued a revision of the section of the *Academic Personnel Manual* dealing with appointment and promotion in the professorial series. The revision agreed upon by the president, in consultation with the Academic Senate, reflects the spirit of the Task Force recommendations and most of the proposed changes in the statement of criteria governing the evaluation of faculty performance, differing in most instances only in emphasis.

effort well beyond current practice. We urge that peer evaluation of teaching be given the same emphasis now given to peer evaluation of research.

2. Applied research is a vital aspect of the mission of the university. Faculty whose scholarship focuses on application of knowledge should be encouraged and rewarded for meritorious achievement....Contributions by faculty to the professional literature and to the advancement of professional practice or of professional education should be judged creative work when they present new ideas or incorporate scholarly research.
3. The development of human resources through personal mentoring and active involvement in affirmative action and other equity- and diversity-oriented pursuits is integral to the life and purpose of the university. Teaching and mentoring of students or new faculty, particularly those of underrepresented groups entering the university community, are to be encouraged and given recognition in academic personnel actions. Such teaching and mentoring are applicable in each area of faculty performance. This is a shared responsibility of all faculty.
4. Changes in emphases and interests that occur during an academic career are both inevitable and desirable. It is appropriate at all levels of review to exercise flexibility now authorized by university policy in evaluating faculty performance.

## Conclusion

In the final analysis, success in achieving the institutional mission rests squarely upon the faculty. It is we whose evaluations and judgments of the work of our colleagues set the milieu for the academic life of the institution. We have deep responsibility for setting both the terms for what is understood to be the scope of activities of faculty and for defining the measures of superior intellectual attainment. Administrative decision rests heavily on the quality, encompassment, and balance of our evaluations. The unqualified commitment of our time and energy is the minimum requisite for our mission's full expression. Short of this, we will certainly perish while we publish.