WHO'S IN CHARGE OF AMERICA'S RESEARCH UNIVERSITIES?

A Blueprint for Reform

Thomas J. Tighe

State University of New York Press

Contents

Chapter 1

The Growth and Impact of Research Universities

This book is about an institution that preserves and enlarges our base of knowledge, trains our scientists and scholars, educates our professional and managerial workers, creates technological innovations that drive the economy, devises medical and engineering advances that enhance our well-being, critiques our social, political, and economic institutions, recaptures our past, enriches our cultural and aesthetic lives, and informs virtually every aspect of our activities in a knowledge-based world. It is about the American research university.

Although research universities comprise a relatively small number of American colleges and universities, they nevertheless play a pivotal role in both higher education and national welfare. The United States has more than 3,500 colleges and universities of which more than 2,000 offer only associate or bachelor's degrees. Of the remainder, 125 are considered to be research universities under the commonly accepted classification system developed and employed for many years by the Carnegie Foundation for the Advancement of Teaching. The defining features of research universities are, first, that they offer graduate education through the doctorate across the arts, sciences, and professional schools, and second, that their faculties are expected to be active contributors to new knowledge in their fields and to be successful in the highly competitive arena of federally funded research, particularly within the sciences and engineering. It is important to underscore the fact that a research university embraces general education and the major areas of undergraduate education as well as graduate education and research. The comprehensiveness of this mission is at once a distinctive feature of the research university and a major challenge for these institutions.

While these universities comprise a well-recognized subset of America's colleges and universities, there is considerable variation among its members. They include long-established institutions that are considered to be the country's premier universities by academic peers and the public alike, for example, such well-known institutions as Harvard, Yale, Princeton, Stanford, Michigan, Berkeley, and Massachusetts Institute of Technology. They also include more recently founded and lesser-known institutions that developed rapidly in their research capabilities following World War II but whose graduate and research programs have not as yet attained the breadth and stature of their historically primary brethren. But all are alike in placing a strong emphasis on research and scholarship, mounting a broad span of doctoral degree programs, and maintaining a relatively high level of extramural research support.

These research universities are also part of a continuum of higher educational institutions, rather then being a fully discrete category. That continuum can be described in terms of progressively higher levels of education offered and correlated emphasis on research and scholarship, extending from the two-year degree programs offered by community and technical colleges, to the four-year liberal arts baccalaureate institutions, to the baccalaureate plus master's degree institutions, and finally the baccalaureate through doctoral level institutions with increasing comprehensiveness at the graduate and research level. Each type of institution plays a distinctive and extremely valuable role in higher education, and all participate in teaching and scholarly activities in varying ways and degrees. Within this continuum, the research universities can be viewed as providing the most complete, albeit not necessarily the best, expression of the teaching, research, and service functions common to all, and certainly the strongest expression of the research function. It is also tempting to ascribe a progressive or developmental aspect to this educational continuum, that is, to think of institutions as seeking to offer more advanced degree programs and to develop greater research capabilities. In fact, in the decades following World War II, a number of master's and doctoral level institutions did evolve into research universities, largely as a consequence of the major infusion of federal research funding during that period. However, the majority of community, liberal arts, and master's level colleges take justifiable pride in their primarily teaching and service missions and have little interest in expanding their research role. But it is equally clear that there are a number of master's and doctoral level institutions today that aspire, often baldly, to the status of "a research university."[1]

Perhaps the most important commonality among higher educational insitutions is the strong scholarly base of their educational programs. Even those institutions whose primary function is undergraduate teaching–the community and liberal arts colleges–will draw heavily upon the fund of specialized knowledge created and nurtured in the research universities and certainly will value scholarly attainment in their own faculties, many of whom will have received their advanced training in research universities. All of these continuities are important because they indicate that while the focus of this book is the research university, the analysis has implications for universities and higher education as a whole.

The disproportionate and pervasive impact of the research universities is succinctly expressed in the following excerpt from the report of the Boyer Commission, a panel of distinguished leaders of higher education recently convened in review of the status of undergraduate education in the research universities:

> The country's 125 research universities make up only 3 percent of the total number of institutions of higher learning, yet they confer 32 percent of the baccalaureate degrees, and 50 percent of the baccalaureates earned by recent recipients of science and engineering doctorates (1991–95). Their graduates fill the legislatures and boardrooms of the country, write the books we read, treat our ailments, litigate our issues, develop our new technologies, and provide our entertainment. To an overwhelming degree, they have furnished the cultural, intellectual, economic, and political leadership of the nation.[2]

To this it might be added that the research universities also exert a disproportionate influence on education at all levels since they are the source of many of the teachers, particularly those trained at the advanced or graduate level, as well as many of the pedagogical models and concepts, for the nation's educational system.

The critical role of these universities is further highlighted by the awareness that research and technological innovation will be increasingly important in determining a society's standing in what is now recognized as a globally competitive, knowledge-based economy. Research universities, with their focus on the production and application of knowledge, have in fact been a vital factor in this nation's social and economic development, as we shall shortly attest, and their key contributions to national and international economic development can only be expected to increase.

These institutions are also most commonly identified in the public's mind with higher education and with its perceived strengths and weaknesses. For example, it is the research university that is the acknowledged

world leader in the training of scientists and professionals, and it is the research university that the public has in mind when charging higher education with neglect of teaching, irrelevant research, excessive costs, abuse of tenure, and other alleged shortcomings. And ironically in view of these charges, it is the same research university that is being called upon, particularly by the business and political communities, to expand and diversify undergraduate enrollment, to increase cutting-edge research and technology, to assist reform of K-12 education, to increase lifelong learning opportunities, to become more engaged in programs of public service, and to assist in building a multicultural and internationally sensitive society!

In sum, whatever its shortcomings, the research university has been, and is widely expected to remain, a leading player in higher education and society as a whole. Nevertheless, the thesis of this book is that it may be seriously questioned whether these universities, as presently structured and supported, can long maintain their critical role and distinctive contributions. At the root of this concern is a growing gulf between the traditional perspective and objectives of the faculty of research universities, which are primarily long-term and basic in nature, and the contemporary perspective and objectives of the university-governing structures and society at large, which tend to be short-term and applied in character. A number of factors underlie and promote this separation, which as yet is poorly understood by either party. But unless the separation is recognized, understood, and effectively addressed, the special strengths and contributions of these institutions are vulnerable.

In order to understand how we have reached this state of affairs, it will be helpful to consider first the factors that gave rise to the research university, to its distinctive character, and to its wide-ranging impact on society. Only by understanding the rationale of the research university and the conditions that fostered the growth of university research can we appreciate the dilemma that confronts us today.

The lineage of the American research university can be traced to the nineteenth century, which saw the first clear appearance of research and scholarship as a priority within American colleges and universities. Up to that point, higher education had been dominated by classical learning–the study of Greek, Latin, philosophy, history, literature, and a smattering of natural science. College education in this form was still mostly for the few and the elite, and was intended chiefly as a preparation for the ministry, the professions, and public service. In the latter part of the nineteenth century, increasing dissatisfaction with the limits of the classical curriculum, and an awareness of the growing accomplishments of the new scientific

research in Europe, prompted American leaders to seek a form of higher education that would be both more rigorous and more germane to the needs of a pluralistic and pragmatic society.

In this reaction, American educators were strongly influenced by the earlier educational developments and reforms of their European counterparts, particularly the model of German universities, which had become world leaders in scientific and scholarly research within the university setting. As in America, German reform of higher education was directed against the strong hold of classical learning, which was seen as an arbitrary passport to positions of privilege and a questionable preparation for the professions. The German reformists believed that the development of more specialized fields of knowledge, based upon scholarly research, especially the new scientific research, would provide a sounder and more democratic basis for higher learning and entry into the professions. Furthermore, and most importantly, these fields were to be taught by faculty trained in methods of scholarly inquiry and actively engaged in scholarship, that is, actively engaged in the production and refinement of knowledge in their fields.

Following the German model, and with much the same purpose and objectives, American universities also began to add advanced science-based curricula and to recruit faculty trained in research methods. In 1876 Johns Hopkins University became the country's first institution devoted to graduate education and research. About this time, Yale University, Harvard University, and the University of Michigan had also begun to add programs of advanced study in the sciences. Other leading universities soon followed suit and over the early part of the twentieth century a research and scholarly emphasis was added to many of the nation's established colleges and universities, both private and state institutions. However, in important contrast to the German model, the growth of specialized fields of scholarship and teaching in American universities tended to develop at the graduate level, supplementing rather than replacing the classical liberal arts undergraduate curriculum, which remained as a traditional form of general education.

At the heart of these nineteenth-century European and closely related American reforms was the conviction that higher education at all levels should emphasize the teaching of specialized knowledge informed by scholarship and research. The knowledge to be offered by a university should go beyond that bequeathed by classical learning and tradition. It should be the product of continuing application of rigorous and objective methods of inquiry. If specialized knowledge and competence in a field were what higher education was expected to certify, then the best way to assure that knowledge and competence was by means of the scholarly

foundation of the field and by the scholarly merit of its faculty. Research became the foundation of a sound education. This philosophy has been, and remains, a distinguishing feature of European and American higher education.

Research universities, then, have existed in the United States since the last quarter of the nineteenth century. In the absence of the consensual definition of "the research universities" that was later provided by the Carnegie criteria, the Association of American Universities (AAU), founded at the turn of the century, provides a measure of the number and growth of research universities over the first part of the twentieth century. The AAU was formed with the objective of raising the standards for graduate education and research in America. Its members, historically well-established and prestigious institutions, thought of themselves as research universities and were generally recognized as such. The AAU grew from fourteen founding members in 1900 to thirty-two American universities by the outset of World War II.

While relatively small in number, these early research universities nevertheless claimed a disproportionate share of both the college student population and total resources available to higher education at the time. While the inception of research as a primary feature of higher education in the United States was a consequence of adoption of the German model, the modern and distinctively American research university developed primarily as a result of several other initiatives that took the form of partnership endeavors between the federal government and the university community. These partnerships were spurred by the desire to promote the production of knowledge in areas of national self-interest and by the recognition that universities, particularly in their science base, had become a wellspring of expertise and knowledge for the nation.

The first of these initiatives began in the latter half of the nineteenth century in the form of the land grant legislation initiated by Vermont Senator Justin Morrill. The Land-Grant acts fostered the creation and development of public universities in each state that were to be accessible to all and dedicated to public needs. The land grant institutions were given a special mission to address the nation's needs in agriculture, at that time the dominant industry and occupation in America. Through the Morrill Act and through subsequent related legislative actions, these needs were addressed by the establishment of both "experiment stations," which had the explicit mission of conducting scientific research in disciplines relevant to agriculture, and "extension stations," which had the mission of directly communicating the research findings to farmers and other agricultural

workers, both operating within the land grant universities. The land grant program, then, supported by federal and state funds, both strengthened basic university research across areas germane to agriculture and provided for rapid transfer and application of the research findings in the everyday world of agriculture. This was a visionary program based on the belief that large-scale support of basic university research could be a key to economic progress. The recognition of the ultimately pragmatic import of basic knowledge, which inspired the land grant movements, was succinctly conveyed by Morrill in introducing the land grant legislation:

> The modern achievements of skill, enterprise, and science, new ideas with germs of power, must be recognized, and diligently studied, as they have brought and continue to bring daily competition which must be met. If the world moves at ten knots an hour, those whose speed is but six will be left in the lurch.

"New ideas with germs of power." What a marvelous expression of the applicability and utility inherent in all knowledge!

There are today about seventy universities designated as land grant, at least one in each state. Most of these have evolved into major state institutions, and many are among our most distinguished research universities. In virtually all, the missions of the production and dissemination of knowledge in the public interest have come to characterize the programs of the institution as a whole, albeit to a less focused degree than in the agricultural colleges.

There is probably little need to document here the effect of the Morrill legislation and the federal-university partnership it embodied on the growth and productivity of American agriculture and related industries. A recent review of the impact of the colleges of agriculture at the land grant universities by the National Research Council summarizes the story very well:

> In 1860 at the dawn of the decade that would put the land grant college system in the history books, one-half of the U.S. population lived on farms and more than one-half of the labor force worked on them. . . . In the decades that followed, however, U.S. citizens left farming in massive numbers for other ways of life and alternative types of employment. By 1990 the farm population was less than one-third of what it had been in 1860 (and fell to only 2 percent of the U.S. population and 3 percent of the labor force). . . . It is important to understand that these trends, in addition to having changed the profile of the national landscape, are also indicators of economic progress. The same number of farms and farmers can feed vastly larger numbers of people today than 100 years ago. The fact that so many more people

> could be fed with relatively little farm labor input meant that farm workers became available to other industries–industries that taught them different skills and paid them higher wages. Essentially, the release of labor from farming fueled the growth of the rest of the U.S. economy . . . . The colleges of agriculture generated many of the scientific and management advances that contributed to the growth of productivity in U.S. agriculture. Such advances include hybrid seeds, improved farm and production management techniques, improved genetic stock of food animals, and sophisticated financial management strategies . . . .
>
> The application of farm chemicals, combined with other yield-enhancing technologies such as improved crop varieties, has made it possible to produce more food and fiber on virtually the same amount of land. Yield-enhancing technologies have also helped the United States become the world's leading exporter of farm and agricultural products.[3]

There is certainly little doubt that the land grant initiative has proven spectacularly successful in raising American agricultural production and processing to its present preeminent worldwide position.

The Second World War and its aftermath produced a broader expansion of the links between the federal government and the academic research enterprise. While the Civil War and World War I had fostered a recognition of the advantages of utilizing scientific expertise and research to assist the conduct of the war, it was not until World War II that the government sought to deploy toward that end the knowledge and expertise of public and private universities and its national research laboratories. University expertise contributed significantly to the national war effort in many key areas such as training, communications, remote sensing, transportation, logistics, the treatment of injury and disease, and of course the development of armaments and explosives. Probably the best-known and most powerful example was the enlistment of university scientists and research laboratories in the team assembled under the direction of Prof. Robert Oppenheimer in development of the atomic bomb, an effort that literally ended the war. Such striking evidence of the consequences of basic and theoretical research, upon which the project was based, helped to promote a national understanding of the link between "academic" research and practical affairs.

The decisive advantage conferred by science in wartime led President Roosevelt to request that Vannevar Bush, head of the wartime Office of Scientific Research and Development, undertake a study of how the

> information, the techniques, and the research experience developed by (your office) and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the

> national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living.[4]

Bush's report in response to that request, entitled "Science–The Endless Frontier," was submitted in 1945. It proved to be a truly visionary and seminal document. His report outlined a new partnership between the federal government and scientific research, a partnership that more than any other factor, defined and fueled the growth of the modern research university. The premise of Bush's report was that basic scientific research directed to the continuous production of new knowledge is absolutely essential to the nation's health, security, and prosperity. While basic research by definition is not directed to practical ends, Bush argued that it is nevertheless essential to the creation of the knowledge from which practical applications inevitably arise. In Bush's words,

> Basic research . . . creates the fund from which the practical applications of knowledge must be drawn. New products and new processes do not appear full-grown. They are founded on new principles and new conceptions, which in turn are painstakingly developed by research in the purest realms of science.[5]

Accordingly,

> The government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent in our youth. These responsibilities are the proper concern of the Government, for they vitally affect our health, our jobs, and our national security. It is in keeping also with basic United States policy that the government should foster the opening of new frontiers and this is the modern way to do it.[6]

More specifically, the report called for (1) public funding of basic medical research in the medical schools and universities, hitherto dependent primarily upon private sources; (2) programs of military research conducted by civilian scientists to "continue in peacetime some portion of those contributions to national security . . . made so effectively during the war";[7] and (3) the creation of a national pool of "scientific capital" by training a significant cadre of scientists and by strengthening the nation's centers of basic research, principally its colleges, universities, and research institutes.

It is important to underscore that Bush gave colleges and universities the lead role in generating the flow of new scientific knowledge that he deemed so essential to the nation's well-being. As he stated,

> These institutions provide the environment which is most conductive to the creation of new scientific knowledge and least under pressure for immediate,

> tangible results. With some notable exceptions, most research in industry and in Government involves application of existing scientific knowledge to practical problems. It is only the colleges, universities, and a few research institutes that devote most of their research efforts to expanding the frontiers of knowledge.[8]

And, as Bush emphasized, expanding the frontiers of knowledge inevitably leads to new enterprises. In further support of the logic relating university research and the production of knowledge leading to practical applications, and with reference to the earlier Morrill Act, Bush noted that "For many years the Government has wisely supported research in the agricultural colleges and the benefits have been great. The time has come when such support should be extended to other fields."[9]

To discharge these new responsibilities of federal government, the Bush report called for the creation of an agency specially designed to support basic research and to administer a program of science scholarships and fellowships, again primarily through the university structure. In the ensuing years, Congress endorsed the major postulates and proposals of the Bush report through several actions including the creation of the Atomic Energy Commission and scientific offices in each of the armed services, a significant expansion of the National Institutes of Health, and most central to the Bush report, creation of the National Science Foundation (NSF). The National Science Foundation was given broad scope and authority to promote national policies for scientific research; to foster general science education and advanced science training; and to support basic research in the natural sciences, mathematics, and engineering. The focus on the natural sciences and engineering stemmed from concern about the shortage of students in these areas who, but for the war, would have received bachelor's and advanced degrees but who were now sorely needed for the transition to a peacetime economy. Eventually the NSF fulfilled the broad conception of supporting basic research throughout the sciences when Congress directed the sponsorship of research in the social sciences in 1968.

The NSF began with a modest budget of $3.5 million in 1951 and its fifth budget was but $16 million. But its budget grew by 1960 to approximately $150 million, spurred in part by the national reaction to the launching of Russian *Sputniks* and by the perceived threat to American scientific leadership. By 1980, the NSF appropriation had expanded to $1 billion, and its research budget today is $5.0 billion. While consistently maintaining the support for basic research that characterized its early years, the NSF has greatly expanded its support across the sciences and added many important programs strategically directed to nurturing the science strength

of the nation, including development of specialized national research consortia, enhancement of science instruction at all levels of education, and construction and renovation of laboratory and other support facilities in universities and research institutes. Throughout these efforts, support of university research programs and utilization of university expertise have remained centerpieces of the NSF agenda.

Equally important to the increased funding of university research has been the manner of that funding, which stressed not only basic research but research of the very highest quality as determined by competitive peer review processes, that is, by the leading scientists themselves. Furthermore, administration of the new funding followed Bush's recommendation that "Support of basic research in the public and private colleges, universities, and research institutes, . . . must leave the internal control of policy, personnel, and the method and scope of research to the institutions themselves. This is of the utmost importance".[10] In essence the NSF model, which has also characterized the National Institutes of Health and other federal agencies supporting university research, helped to foster development of a uniquely American partnership between the government and universities–what has come to be called "the social contract for science." As summarized by David H. Guston and Kenneth Keniston,

> The bargain struck between the federal government and university science . . . can be summarized in a few words: government promises to fund the basic science that peer reviewers find most worthy of support, and scientists promise that the research will be performed well and honestly and will provide a steady stream of discoveries that can be translated into new products, medicine, or weapons.[11]

Fundamental to the contract, of course, was a strong faith on the part of both parties in the practical, as well as in the intrinsic, value of fundamental knowledge.

Of course, basic and applied research are parts of a continuum, and research is thus always relatively pure or relatively applied. Inevitably, the pressures of immediate national problems have resulted in departures from a strictly basic research agenda by the NSF and by other federal agencies; and governments have always targeted and prioritized at least broad areas of research in the national interest. Calls and pressures for greater support of applied research goals are a consistent part of the political and scientific landscapes, and constitute a debated issue today. Nevertheless, support of basic research, peer merit review, free inquiry, and self-monitoring have been consistent hallmarks of the "contract" between the government and

science in the United States, and virtually all quarters would agree that these have been important elements in the postwar development of American science and the research university to their current positions of worldwide preeminence.

Several additional federal initiatives also contributed in significant measure to the growth of the research universities. We have already mentioned the salutary increase in the NSF budget associated with the Russian *Sputniks*. But the *Sputniks* also produced broader federal action to counter this apparent threat to American security and presumed leadership in science and science education. The National Aeronautics and Space Act of 1958 created the National Aeronautics and Space Administration (NASA) with major funding for research on space science and technology, much of it conducted in universities. A related initiative was the National Defense Education Act of 1958, which provided large-scale funding through the Office of Education to strengthen science education and the development of scientific talent at all levels of education. Colleges and universities again played a major role. Fellowships and loans supported university students in germane fields of science, thousands of the nation's high school teachers came to university campuses to update their knowledge and strengthen their science teaching skills, and university scientists assisted the development of new curricula for the nation's schools.

Finally, Higher Education acts in 1963 and 1965 provided capital support for a broad program of facilities construction and renovation in the nation's colleges and universities, with science facilities a major part of the outlay. While *Sputnik*-related pressures played a prompting role in this action, the renewal programs proceeded from longer-standing concerns about the aging state of university and other research laboratories, a greatly expanded university enrollment (the post-World War II baby boom), and the need to keep pace with the rapid rate of scientific and technological change. A significant aspect of these efforts was a deliberate effort to broaden the ranks of "elite" science institutions by strengthening the facilities, research, and educational programs of institutions aspiring to become research universities.

The Land Grant movement, and the creation and funding of the National Science Foundation, the National Institutes of Health, and other federal agencies responsive to university research programs and needs, and the national defense and higher education acts of the '50s and '60s were the major steps on the federal level to make universities, in Dale Wolfe's phrase, "the home of science." Of course, other more specific and local actions played a significant role as well, particularly the support given to

universities through systems of state and private funding. Recall that Bush had viewed strong public and private universities as constituting the environment most conducive to the creation of scientific knowledge. Bush and his colleagues recognized that the universities provided the most appropriate existing infrastructure of any real scale within which to foster the pursuit of knowledge for knowledge's sake and the development of scientific talent. But the existing infrastructure, including the availability of faculty, students, supporting academic programs, buildings and facilities, was (and still is) primarily maintained though state and private support. And of course these funding constituencies come with their own distinctive and urgent claims on the universities. Specifically, they expect of universities a strong commitment to the teaching and personal development of undergraduates, a broad array of educational programs through the professional level, and responsiveness to the social and economic needs of their regional communities. The development and accomplishments of the research universities have been all the more remarkable in view of the multiple functions demanded by its differing patrons.

Under the federal-university partnership initiatives we have described, support of university research expanded dramatically during the quarter-century following World War II, changing the landscape of university research forever and giving definition and substance to the concept of the research university. While the rate of increase in public financial support of university research slowed markedly beginning in the 1970s, overall support has remained relatively stable, and the research universities continue their distinctive and critical role in the national science agenda.

The remarkable success of the American research university has been widely recognized here and abroad. It is fair to claim that the accomplishments of scientific research in our colleges and universities is one of the great success stories of our nation. American research universities have combined the functions of teaching, research, and service in a fashion that has become a model for the rest of the world. As Varten Gregorian has noted, "As many as three quarters of the best universities in the world are located in the United States. What sector of our economy or society can make a similar claim?"[12]

Accompanying the externally visible growth of research universities was the less visible growth of a set of values that have come to characterize the faculty of these institutions. While these values have a strong link to the turn-of-the-century incorporation of scholarship into the mission of higher education, they achieved full definition only under the stimulus of the partnership initiatives and other external support we have reviewed.

Indeed, for many faculty, the "social contract" is what gave shape and legitimacy to these values.

Let us go back in time to the '40s and '50s and consider the university scientists that Bush had in mind when formulating his call for federal support of university research. First and foremost, they were *professors* who in the root sense of that word, cultivated and taught their special field of knowledge as their life's work. They fit the classic mold of the university teacher-scholar who devoted his or her life (largely his at the time) to teaching the methods and findings of their particular disciplines, to training professional scholars, and to curiosity-driven inquiry. They were "ivory tower" with little concern for application of their fields to the practical world of affairs or toward the creation of new technologies and products. Rather, their focus was scientific explanation of the natural world. Their salaries were modest and they enjoyed little of the financial support for research and few of the professional perquisites available to contemporary academic scientists. In general, the resources of the university classrooms and laboratories and the support network of academic publications and professional societies were adequate for their purposes.

Now consider from the perspective of these faculty, particularly the science faculty, the impact of the dramatic change in public financial support of university research. As indicated, prior to World War II there was little external or internal financial support of faculty research. While there were, as always, a small number of scholar stars known to the general public, federal funding was virtually nonexistent and relatively few faculty benefited from the limited support available from private foundations. While faculty were expected to be scholars in their fields, university support for research typically amounted to little more than a general recognition that research was part of a faculty member's assigned duties. There was little if any explicit provision of time for research within a demanding schedule of teaching and teaching-related responsibilities. Most faculty were left to their own devices to pursue their scholarship, which they typically accomplished through long work hours.

In contrast, after World War II university faculty were suddenly being told that what the nation now wanted–and was willing to pay for through the universities–was more scientists and more research. Now there is nothing that scientists want more than more science–that is, they want expanded opportunities to pursue their research interests and a strengthened overall science enterprise. If anything, university scientists especially fit this mold. They are, after all, individuals who have chosen to dedicate their lives to scientific research and to the teaching of science,

often in its purest and most basic forms. To be told that significant funds were now available to enlarge what they most valued, providing they were willing to undergo the peer review required to prove its merits, would appeal greatly at once to their minds, hearts, and inherently competitive natures.

The university scientific community responded strongly. The bulk of the initial funding, largely channeled through competitive grant application processes, went to science faculty and science departments of what were regarded as the nation's strongest universities. And these faculty, like all faculty, were inclined to train their graduate students in their own image. That is, they produced well-trained basic scientists who tended to pursue knowledge for knowledge's sake and who generally aspired to and followed careers in university teaching and research, where they in turn imparted similar training, values, and goals to the next wave of students. With successive funding cycles, the supply and placement of well-trained researchers increased significantly and a wider range of universities were able to benefit from the funding process.

The university research enterprise grew steadily in scope and numbers with larger graduate enrollments across the sciences and significant expansion of science departments. Not only did university science departments expand, but the ranks of the research universities also themselves increased. Institutions that prior to World War II had engaged in modest or little research activity, or that had once been teacher's colleges or master's level institutions, developed into relatively robust research universities. These institutions recruited the new waves of trained scientists, and were assisted not only by federal funds but also by state governments that were convinced of the economic benefits to be expected from expanded research and technology. The obvious contributions of academic research to economic development in areas such as Silicon Valley in California and along Route 128 in Massachusetts bolstered the perception of "world-class research universities" as desirable drawing cards for business and industry, and persuaded many states to strengthen the research capacities of their universities. In fact, the enlarged university research enterprise has been critical to the development of numerous new products as well as to entire new industries. The pervasive benefits that have stemmed from university research are well summarized in the following statement of the National Association of State Universities and Land Grant Colleges.

> Since the end of World War II, federally-funded basic and applied research at universities has expanded the base of knowledge, improved American's quality of life dramatically and helped make the U.S. an economic superpower. Indeed, research accomplished at institutions of higher education has touched

> the lives of almost every American. University research has improved the environment, creating cleaner energy resources and new ways to reduce or eliminate pollution. It has prompted better health, saving lives and raising the quality of life through creating new vaccines, drugs, procedures and medical equipment. And university research has boosted the economy. Reseachers have made discoveries that laid the foundation for industries such as electronics components, plastics and new materials, computers and software, telecommunications equipment and services, pharmaceutical and medical equipment, and aeronautics. These cutting-edge enterprises create millions of jobs and contribute over $600 billion per year to the economy.[13]

The Bush vision amply confirmed!

During this post-World War II period of growth there also evolved within many universities powerful reward systems that encouraged faculty to give priority to research. These rewards included increased time for faculty to pursue their deepest intellectual interests, increased weight for scholarly accomplishment in tenure and promotion decisions, the provision of improved laboratories, expanded libraries and other facilities in support of research, support for travel and participation in professional meetings, university awards and recognition for scholarly accomplishments, graduate student teaching and research assistants, and support for administration of faculty grants and contracts. Note that these university rewards offered little or nothing in the way of direct monetary benefit to the faculty. Rather they were directed chiefly toward expansion of research itself or the creation of a more supportive environment for research. These incentives not only acted to amplify the research activities of the faculty but also visibly signaled the value given to research within the whole university community. Further, and most significantly, the elevation of research as a faculty priority was not limited to the natural science areas but tended to spread across the social sciences, humanities, and arts as well. Even though the external and internal reward structures for scholarship were (and remain) much weaker outside the science areas, there grew an increased expectation within the research-oriented universities that faculty across the board should be active and accomplished scholars in their fields. Research universities today are in fact characterized by the presence of strong scholarly faculty across the academic disciplines.

In sum, from the faculty perspective, university professors did exactly what society called on them to do. That is, they significantly expanded their research activities and the production of scientists. They achieved these ends largely through their own efforts and merits, that is, by competing for the necessary resources in a rigorous peer review process. While their thrust as university scientists was naturally toward the long-term

development of basic research capacities (the necessary base in Bush's strategic vision), they also responded vigorously to calls for research in areas of national interest and applied significance. Universities whose faculties were successful in the competition for funding developed stronger research programs and research environments, which in turn aided in the recruitment of research-oriented faculty. Internal reward systems were adopted that encouraged engagement in research across the disciplines, and their faculties embraced this vision. The result of the play of these factors was the elevation of research in a number of universities–in general, one could say in the research universities–to a new prominence. Indeed, in these institutions research and scholarship emerged clearly as the foundation for the whole university enterprise.

The latter observation is important. Why should a largely science-focused initiative have had such a general impact on the university? Why should strengthening scientific research have had such a spread of effect on scholarship across the disciplines? Why was the social contract interpreted in such broad fashion by the faculty? The answer is fundamental to understanding the life force of the university. It links back to the factors underlying the initial incorporation of research into higher education but proceeds most directly from the faculty's profound belief in research and scholarship as the necessary foundation for academic knowledge. Let us examine this assertion in relation to the overall mission of the university.

The three basic time-honored functions of the university–teaching, research, and public service–are all very important. Generally a research university cannot neglect any of them, and would do so at its peril, not only peril to fulfillment of its mission, but to its funding base as well. All three functions must be highly valued and nurtured. But one, in the minds of most faculty, has a clear logical primacy–and that is research, regarded as scholarship in all of its forms, whether creative activity in the arts, experimentation in the laboratories, new knowledge or interpretive studies in the humanities, or whatever the disciplinary form of inquiry and creation may be. The primacy of research stems from the recognition that the cumulative research, scholarship, and creative activity of the faculty is ultimately the source of what is taught and the source of an institution's ability to add value to society by way of public service. That is, universities teach and apply the results of long-term disciplined inquiry. They teach and apply the output of methods of study which, across the wonderful fabric of the many disciplines that comprise academia, are continually fashioned to be as free as humanly possible of error, distortion, and bias–as reasoned and objective as possible–as true as possible.

A fundamental fact of life is that all of us must depend for what we know largely upon what we learn from others, and we must depend on that received knowledge to be reliable, truthful, and useful. Nowhere is that dependency more evident than in formal education. Therefore, trust is a fundamental part of education. And in the academic world, trust must be earned and credibility based on the soundness of knowledge, and that means on the ability to produce and evaluate what is most true through continuing processes of inquiry, invention, interpretation, questioning, sifting, and refinement of knowledge–that is, through the continuing research, scholarship, and creative activity of the faculty. Research, then, is the foundation of a great university and the base of value for all of its functions. It provides the source and inspiration for outstanding pedagogy and it furnishes the knowledge base from which may be drawn answers to the myriad problems that plague society as well as inventions to improve the quality of life. To be recognized as a research university thus attests to the strong scholarly base of the university and to the overall quality of its endeavors in teaching, research, and public service. It is for these reasons that institutions and their faculties often aspire to the status of a "research university"–because that status speaks in a broadly recognizable way to the overall soundness and quality of the whole institutional enterprise.

Respect for scholarly research as the bedrock of academic knowledge, a commitment to basic knowledge but a responsiveness to research needs in the national interest, a willingness to put themselves on the line in the competition for resources and in the arena of peer evaluation, and what is at core an intrinsically motivated desire to know and understand,–these are the faculty values associated with the astonishing growth of the research universities through what arguably has been the period of greatest achievement ever in American higher education in terms of expansion in basic and applied knowledge and, simultaneously, of access to higher education. These accomplishments have provided models for the world. Society should cheer and take pride in these successes and celebrate the skills and traits that underlie them. Yet research universities and their faculties find themselves today increasingly estranged from their governing structures and society. The chapters ahead will seek to account for the causes and factors underlying that divergence, to which faculty, governing structures, and society alike have contributed.

But do such ties influence the investigator's opinion or behavior? The typical faculty researcher's reaction to this question is likely to be one of indignation. They are confident and sincere in the belief that the methods of science together with their own rigorous training and basic honesty protects against possible conflicts of interest. Furthermore, they are keenly aware that their reputation for reliable science is the most important possession they have. Nevertheless, any scientist will tell you that they must always be on guard against possible sources of error in the design, conduct, and interpretation of experiments, and modern experimental psychology has convincingly demonstrated how expectations and motives may induce selectivity in perception and thinking, even without the individual's awareness.

Several studies have put the question of industry influence on investigators' views to an empirical test. One of the most comprehensive was conducted by a team of Canadian researchers who sought to determine whether there was any relation between investigators' published positions on the controversial clinical question of the safety of calcium-channel blockers as a way to treat hypertension and angina and their financial ties with drug companies that make the blockers.[20] Seventy published articles, primarily review articles and "letters to the editor" rather than reports of original research, dealing with this issue were reviewed and classified as being supportive, neutral, or critical with respect to the use of calcium-channel antagonists. The reviewers had no knowledge of the authors' financial relationships with pharmaceutical companies. The authors of the articles were then independently asked about their financial relationships with manufacturers of these blockers and with manufacturers of competing products. Specifically, they were asked whether they had received any of five types of funding in the past five years from these manufacturers: support to attend a symposium, an honorarium to speak at a symposium, support to organize an educational program, support to perform research, and employment or consultation. When the authors' positions on the use of calcium-channel blockers were correlated with their financial ties, the researchers found that 96% of the supportive authors had received one or more of the types of funding from manufacturers of these blockers as compared with 60% of the neutral authors and 37% of the critical authors, a highly significant difference.

Another relatively large-scale study examined the published outcomes of research studies evaluating the effectiveness of various drugs in relation to whether the research was done under drug company support (40 such articles) or without such support (112 studies).[21] Research done under company support would of course be concerned with evaluating drugs of direct interest to the company. Research studies that acknowledged

support by the pharmaceutical industry were found to be significantly more likely to report results that favored the drug of interest (98% of the articles) than were articles that did not acknowledge pharmaceutical industry involvement (79%). Several other clinical trial studies have reported outcomes of a similar nature.[22]

While these few studies are certainly disturbing, we should be careful about drawing hard conclusions from them regarding the extent to which industry ties may influence the opinions of clinicians and researchers. For one thing, as in any research, there may be possible confounding variables. For example, there is reason to believe that for-profit companies are less likely than independent research institutions to sponsor drug studies unless some evidence already suggests that a particular drug may be effective. If so, this factor could underlie the observed higher percentage of positive outcomes in drug research sponsored by industry. And again, the experimenters in these studies doubtless did their best to pursue objective inquiries, analyses, and judgments. But it would be very naive of universities and their faculties to assume that the general public would not be both very disturbed by such findings and most uncomfortable if it knew the extent of undisclosed financial ties between university scientists and industry. The gravest threat of all from extensive industry ties to university researchers may be the erosion of confidence in universities as centers of disinterested inquiry in the public interest.

Some argue that this threat might be countered in good part if university investigators simply fully disclosed their financial relationships with industry in the course of publishing or otherwise communicating their research findings. Other investigators in the field, and the general public as well, could then evaluate the merits of research reports in the light of the authors' disclosure of possible conflicts of interest. Although there is now a belated and growing concern to require such disclosure, universities, granting agencies, and journals have not yet developed effective policies on reporting conflicts of interest. Current guidelines tend to be vaguely worded and poorly enforced by universities and journals alike. Faculty generally believe that financial sponsorship does not influence their investigative work, and tend to feel that while conflict of interest concerns may apply to others, they are certainly not valid in *their* case. A survey of more than 60,000 papers appearing in 181 peer-reviewed journals in 1997 found that only 5 percent of those papers contained information about authors' financial ties, a figure that is surely but a small fraction of the actual relationships.[23] While a survey of current publications would probably yield a somewhat higher disclosure rate, conflicts of interest disclosure is

clearly a long way from being the norm in research institutions and journal practice.

The concerns about industry-funded research apply as well to the proliferation of industry-endowed chairs and industry-funded research centers, although the tendency to attach company names to chairs and centers diminishes the disclosure issue. Corporations view such support as investments to promote study in areas important to their business concerns, and these concerns are usually short-term and profit-oriented. As Paul Berg, the Stanford Nobel Prize-winning biochemist has observed, industry will support biotechnology projects that might make a profit but not the basic research that made biotechnology possible. They are even less likely to fund a chair in, say, medieval studies, philosophy, or the poetry of Emily Dickinson, nor are university development officers likely to press such scholarly areas on corporate donors. There is a much larger "appetite for giving," to use a fund-raising phrase, to applied areas of university endeavor, such as medicine and engineering.

Since chair endowments always act to augment teaching and scholarship in areas important to the donor, something that cannot be assured for other areas of endeavor, industry funding of chairs can influence the institution's academic priorities. Further, there is always the potential for chair donors to attempt to influence as well the selection of the chair-holder or even the incumbent's specific research and teaching activities. Several disturbing episodes in this vein have been documented, although to this point it appears that most universities have kept donors at "arm's length" in selection of chair-holders and the incumbent's activities. The harshest critics of corporation-donated chairs argue that the donors are motivated more by market savvy than by public-spiritedness. These critics charge that corporation-endowed chairs or business-related research centers essentially use the university to enhance public perception of the corporation and its products by association with the university reputation for objectivity and integrity. The danger, they argue, is that the transfer will inevitably be two-way. That is, by association with commercial enterprises, the university will lose the public perception of being outside the marketplace and thus will lose as well the positive image and confidence in their objectivity that makes them attractive to corporations in the first place. This is a cynical view, but it certainly exists within the ranks of the academy.

There is also concern that the growing pressures on universities to contribute to regional economic development programs may similarly bias the academic program profile. Consider, for example, the thrust of the several university-state-industry economic development programs noted earlier.

Connecticut provided special funding in five university program areas: materials science, pharmaceuticals and biotechnology, environmental technology, marine science, and photonics. The Florida program invested heavily in microelectronics and related technologies. The California program will focus on nanosystems, biotechnology and biomedicine, and telecommunications and information technology. Emily Dickinson loses again.

The selection of these educational and research areas for special investment is certainly understandable. They comprise the most fertile ground for translational research, that is, for research likely to produce technologies that can be moved quickly to the marketplace and provide immediate payoff. But differential expenditures of the magnitudes involved will have sizable differential effects. A visit to any research university today is likely to find ongoing construction, the best educational and research facilities–and the majority of students–in these highly funded areas. In chapter 4 we noted that an increasing utilitarian attitude of students has been reflected in a notable decrease in course and major selections within the arts and sciences and a corresponding increase in business and vocationally related disciplines and majors. A recently reported national study of this question found that from 1970 to 1994 the number of bachelor's degrees in English, foreign languages, philosophy, and religion all declined, while there was a five- to tenfold increase in degrees in computer and information sciences, changes that the study authors attributed to the new "Market-Model University."[24] Ironically, this skewing of academic program priorities runs directly counter to what the business community in repeated surveys has indicated as their greatest need–graduates with strong critical thinking, perspective-taking, and communication skills and the ability to work in cross-functional and cross-cultural teams, all capabilities to which the humanities and liberal arts contribute significantly. The risks of an overly strong business orientation in higher education has been eloquently expressed by Michele Tolela Myers, the president of Sarah Lawrence College:

> We borrow the language of business because we are forced to operate like businesses. Higher education has become more and more expensive at the same time it has become increasingly necessary. As we look for ways to operate efficiently and make the most of our assets, we begin learning about outsourcing, for-profit ventures, the buying and selling of intellectual property. . . .
>
> As we in the academy begin to use business-speak fluently, we become accustomed to thinking in commercialized terms about education. We talk no longer as public intellectuals, but as entrepreneurs. And we thus encourage instead of fight the disturbing trend that makes education a consumer good rather than a public good. If we think this way, our decisions will be

> driven, at least in part, by consumers' tastes. Are we ready to think that we should only teach what students want or be driven out of business?
>
> Physics is hard, it is costly, it is undersubscribed. Should it be taught only in engineering schools? I don't think so. Should we not teach math because everyone can get a cheap calculator? Should we stop teaching foreign languages because English has become the international language? And what about the arts, literature, philosophy? Many might think them impractical. I think we have a responsibility to insist that education is more than learning job skills, that is also the bedrock of a democracy. I think we must be very careful that in the race to become wealthier, more prestigious, and to be ranked Number One, we don't lose sight of the real purpose of education, which is to make people free–to give them the grounding they need to think for themselves and participate as intelligent members of a free society.[25]

The central tendency of the array of university-industry interactions reviewed in this chapter has evoked such arresting phrases as "the corporatization of the university," "the commercialization of the campus," and "the kept university." A good summary of the import of these phrases–and of this chapter, is contained in a statement by James Robert Brown, a professor of philosophy at the University of Toronto:

> What do these notions mean? To me, they involve an increased dependence on industry and philanthropy for operating the university; an increased amount of our resources being directed to applied or so-called practical subjects, both in teaching and in research; a proprietary treatment of research results, with the commercial interest in secrecy overriding the public's interest in free, shared knowledge; and an attempt to run the university more like a business that treats industry and students as clients and ourselves as service providers with something to sell. We pay increasing attention to the immediate needs and demands of our "customers" and, as the old saw goes, "the customer is always right." Privatization is particularly frightening from the point of view of public well-being.[26]

In summary, although university-industry partnerships bring substantial benefits they also pose grave risks to the revered university traditions of disinterested inquiry, free sharing of information, and broad and balanced pursuit of knowledge. There are those who argue strongly that the risks are not worth the gains, that universities should be overwhelmingly funded from the public purse, or from the private purse without strings, and that we should just say no to any form of philanthropy with its own ax to grind. On the other hand, the university research and scholarly enterprise may have grown in breadth and cost beyond the willingness or even the capacity of public funding to support it. Over the past several decades, universities have gone from exploring private funding, to experiencing its benefits, to depending on it, and that is a hard course to reverse. In this dilemma, it

is tempting to offer the solution of welcoming corporate support while attempting to studiously draw the line on anything that risks the ideals of the university, recognizing that in real life, maintenance of principles is often a matter of degree and common sense.

Is such an approach too risky? One might think so from the popular press, which has generally depicted "the corporatization of the university" as a matter of a strong corporate sector luring an overburdened and resource-hungry academic community to its bidding with the promise of research support and profits, with universities a reluctant but ultimately led partner. But it is important to realize that at the end of the day there can be *no* partnership agreements without the university signature–no technology transfer agreements, no endowed chair agreements, no clinical-trial contracts, and no economic development programs. And it is equally important to realize that in the marriage of business and academia, the primary suitor is business, not academia. True, there are needs on both sides but the needs are greater in business than in academia, particularly in the new knowledge-based economy. There are risks on both sides too, but the risks are far less for business. No business ever went broke paying royalties on the sales of new technologies, endowing chairs, or contracting for research. These are all investments with calculated greater returns. But there is the real risk that academia could lose what business is paying for–knowledge and expertise of unparalleled quality, breadth, objectivity and credibility. The assets of business are replaceable, but those of the academy are not, and in that sense they are priceless. Universities are therefore actually in the stronger position in the negotiation of business-academic partnerships, if they but fully realize it. It is in those negotiations, that is, in the negotiation of actual agreements and contracts, and in the formulation of the policies that condition them, that the defense of academic principles must lie. And in those negotiations, who now represents the university to protect its values and objectives? Not in any effective way the faculty, whose efforts lie at the base of every agreement, but the governance authorities of the university. This does not mean that boards and university presidents are not genuinely concerned with protecting university values or do not attempt to consult faculty in the process. But the fact of the matter, as our analysis of university governance has shown, is that the center of gravity of governance is now strongly biased to the values and objectives of business, and mechanisms for meaningful faculty consultation are virtually nonexistent.

That agreement on policies for university-industry interactions is urgently needed is seen in sharply different views within existing practice. Harvard Medical School, worried that they might have trouble recruiting

and retaining faculty who thought they could make more money at other schools with more lenient conflict of interest policies, recently considered loosening its rules to permit faculty to own more stock in companies that sponsor their research and to earn more money consulting for such companies.[27] After receiving fire from ethicists, Harvard withdrew these proposals, while urging a national dialogue on the issue involving universities, government, and industry. About the same time, Marcia Angell, a lecturer at Harvard Medical School, a former editor of the *New England Journal of Medicine,* and a prominent critic of conflict of interest in industry-sponsored medical research, argued that the best way to restore public confidence in the scientific enterprise is for universities and scientists to *altogether* eschew financial ties with companies that sponsor their research–no consultancies, no equity interests, and no roles as paid speakers for the companies.[28] The fact that such closely associated influential sources have such diametrically opposed views clearly indicates the need for broad debate and consensus on this critical matter. In that debate, the proposed faculty councils on governance could play a most valuable role in representing and advocating the views of the full faculties of their universities.

Specifically, consideration should be given to the following guidelines for industry-university partnerships in the interest of preserving academic freedom: refusing to accept contract research that prohibits disclosure of results; protecting the right to publish with at most a ninety-day delay allowed for patenting; forbidding professors to have financial ties to companies sponsoring their research and universities from investing in those companies; requiring faculty and universities to disclose at the time of publication any conflict of interest that could bear on the research or views reported, and requiring as well clinical-trial investigators to disclose such conflicts to patient subjects; assigning students only to industry-sponsored projects that are fully consistent with their educational goals and training needs; scrupulously protecting students against proprietary restrictions on publication of their work; maintaining "no strings" endowed chair and research center agreements; keeping university-paid faculty time in for-profit activities within current consulting time limits; and prohibiting universities and their scientists from selling or purchasing stock in any company working to commercialize a university invention until well after the product is on the market (Johns Hopkins University has such a restriction to prevent possible manipulation of research results to influence stock value).

In a broader vein, faculty councils could also be helpful to university governance authorities in making the case for legislative and social policies that work to protect unfettered inquiry in the public interest even as

university-industry partnerships are pursued–for example, the case for preserving and enlarging public support for the freest possible dissemination of information, for placing the considered educational needs of students above the interests of business or philanthropy, and most of all, for understanding that the discoveries with the greatest social and economic impact have come from research *not* oriented to market objectives. They might also consider recommending some innovative ways to ease the strains of directed research. One example might be to pursue university-government-private industry collaborations that target research areas important to the public interest but leave substantial freedom for individual investigators in the selection of the research approach and certainly in the conduct and reporting of the research. Another example might be a policy to provide matching financial investment, from state or private dollars, for those university areas that do not benefit from extra funding for economic development or marketplace objectives. The proportionate investment necessary to keep up in these areas would be trivial compared to the millions now flowing to programs more relevant to the marketplace, and as President Meyers of Sarah Lawrence College has pointed out, would serve as well the most important educational needs of a free and advanced society.