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**The Government-University  
Research Partnership:  
Beyond the Endless Frontier . . . ?**

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## Introduction

Perhaps the unique characteristic of higher education in America is the strong bond between the university and society. Historically our institutions have been shaped by, have drawn their agendas from, and have been responsible to the communities that founded them. This unique partnership goes back over two centuries to that famous passage from the Northwest Ordinance chiseled above the entrance to Angell Hall, "Religion, morality, and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged." This laid the foundation for one of America's most remarkable social inventions, the research university.

Because they added a commitment of service to the traditional academic mission of teaching and scholarship, these institutions created a continuing connection between theory and practice. The result has been a powerfully creative engine for progress uniting students and faculty in a collective discovery and transfer of useful knowledge and technology. The American research university, through on-campus scholarship and off-campus extension activities, was first key to the agricultural development of America and then to the transition to an industrial society. WW II provided the incentive for even greater cooperation as the universities became important partners in the war effort, achieving scientific breakthroughs such as nuclear fission and radar. In this period our universities learned valuable lessons in how to develop and transfer knowledge strategically and how to work as full partners with government and industry to address critical national needs.

The seminal report, "Science, the Endless Frontier," produced by a post-war study group chaired by MIT President Vannevar Bush, stressed the importance of this partnership by echoing the spirit of the Northwest Ordinance:

"Since health, well-being, and security are proper concerns of government, scientific progress is, and must be, of vital interest to government." The resulting partnership between the federal government and the nation's universities has had an extraordinary impact.

It has made America the world's leading source of fundamental scientific knowledge. It has also produced the well-trained scientists and engineers capable of applying this new knowledge. This academic research enterprise has played a critical role in the conduct of more applied, mission-focused research in a host of areas including health care, agriculture, national defense, and economic development.

Yet as important as research universities are today in our everyday lives, it seems increasingly clear that in the future they will play an even more critical role as they become the key players in providing the knowledge resources—knowledge itself and the educated citizens capable of applying it wisely—necessary for our prosperity, security, and social well-being. As Erich Bloch, former Director of the National Science Foundation stated it in Congressional testimony: "The solution of virtually all the problems with which government is concerned: health, education, environment, energy, urban development, international relationships, space, economic competitiveness, and defense and national security, all depend on creating new knowledge—and hence upon the health of America's research universities."

But here we have both some good news and some bad news. First, the good news:

### The Good News

The good news is that America's system of higher education is still widely acknowledged to be the strongest and most productive in the world. Earlier this year a *New York Times* editorial referred to our nation's research universities as the "jewel in the crown" of our

national economy. It went on to assert that university research "is the best investment taxpayers can ever make in America's future." This was an especially welcome, if all too rare, acknowledgment since all too often the university today is under attack from all sides.

### **The Bad News**

If the good news is that our universities are the strongest in the world, the bad news is that the 1990s stand a good chance of being the worst for higher education since the 1930s. There is a frightening sense of crisis at many of our nation's most distinguished campuses.

Our universities are at serious risk on a number of fronts. The signs of stress are everywhere:

1. The breakdown of mutual trust has led to increasingly adversarial relationships between universities and government, including Congress, the administration, and federal agencies, as manifested in recent skirmishes over matters such as indirect cost reimbursement, scientific misconduct, and pressures to restrict the flow of technical information.

2. The skepticism—indeed, hostility—exhibited by the media and government has badly eroded public trust and confidence in the university, as revealed by the recent deluge of attacks on the academy, e.g., those who suggest that "most scholarly activity is either the sterile product of requirements imposed by Philistine administrators or a form of private pleasure that selfish professors enjoy at the expense of their students."

3. Forces upon and within the universities, such as the rapidly escalating costs of research, are pushing toward a rebalancing of missions, away from research and more toward teaching and public service.

4. The morale of academic researchers has deteriorated significantly over the past decade, in part due to the pressures and time-consuming nature of the need to obtain and manage sponsored research funding and the disintegration of a "scholarly community" within the university. In a recent NSF workshop, a young faculty member described the modern university as "a holding company for research entrepreneurs."

What is going on here? To some degree, we may be seeing evidence of the increasing estrangement of the American public—and their elected representatives—from science itself. The gap grows even wider between the omnipresent influence of science on modern society and the scientific literacy of the body politic.

We also may be experiencing the same forces of populism that rise from time to time to challenge many other aspects of our society—a widespread distrust of expertise, excellence, and privilege. Unfortunately, many scientists, universities, and university administrators have made themselves easy targets by their arrogance and elitism.

But something else may be happening. Let me comment on several aspects of the current strains on the academic research enterprise that may prove of critical importance in the years ahead.

### **Strains on the Academic Research Enterprise**

#### *The Political-Economic Crisis*

The most immediate stress is coming from the effects of a major political-economic crisis. For one thing, of course, universities are feeling the effects of the current recession both nationally and regionally. However, current fiscal woes are not just temporary set-backs; they go much deeper.

Universities are suffering the consequences of the structural flaws of national and state economies, the growing imbalance between revenues and expenditures, that are undermining support for essential institutions as governments struggle to meet short-term demands at the expense of long-term needs. The electorate has adopted a new credo: "Eat dessert first. Life is uncertain. And, by the way, just send the bill to the kids later--say in a decade or two." The fact is that education at all levels is feeling the effects of two decades of political failure to invest in our people and infrastructure--in our children's future.

The states are in serious trouble. For the first time in thirty years, state support for higher education is dropping. There are few areas of the country in which state support for public higher education will be able to keep pace with inflation during the 1990s, despite the fact that enrollment pressures are now building rapidly as our national demographics shift back to the upswing part of the post-war baby boom/bust cycles.

Cuts in federally supported financial aid have shattered the dream of equal educational access for many students. Our universities have had to scramble to make up the difference in part through increasing tuition for those who can afford the costs of education. So, too, the federal government has embarked upon a massive effort to shift more of the costs of federally sponsored research to the universities. For example, even though university overhead rates are less than one-half to one-third those characterizing other federal contractors in the public and private sectors, efforts have been made both by Congress and the administration to lower overhead reimbursement even further. Excessive cost-sharing requirements have also put serious stresses on universities, forcing them to reallocate resources away from education and service to attract federal research funding.

Both public and private institutions are facing very serious financial difficulties today. While you read in the national press about the staggering budget deficits faced by relatively affluent institutions such as Stanford, Yale, and the University of California, the situation is far more serious in those institutions that do not benefit from massive endowments or generous state support.

There is an additional challenge faced by the best of America's universities. Harold Shapiro has identified what he calls the "1 percent problem" facing those institutions that compete to be the very best in teaching and scholarship. The decade of the 1980s experienced a trend in which the costs of achieving excellence in higher education rose roughly 1 percent per year more rapidly than the available resource base. (Some institutions such as Stanford found this mismatch to be 2 percent or higher.) Most studies project that this trend is likely to continue throughout the 1990s, driven in part by the expanding knowledge base and by the cost structures of quality research and teaching. While a given institution may be able to accommodate such an imbalance between costs and revenues over a short period, it is clear that over the long term, the "1 percent problem" will require a significant restructuring of the mission and activities of the university.

### *The Inability to Comprehend the Modern University*

There is another dilemma here, one perhaps best illustrated by the old parable of the blind men each feeling different parts of an elephant and arguing over just what the whole beast looks like. The modern research university is complex and multidimensional. People perceive it in vastly different ways, depending on their vantage point, their needs, and their expectations. Students and parents want high-quality,

but low-cost, education. Business and industry seek high-quality products: graduates, research, and services. Patients of our hospitals seek high-quality and compassionate care. Federal, state, and local governments have complex and varied demands that both sustain and constrain us. And the public itself sometimes seems to have a love-hate relationship with higher education. They take pride in our quality, revel in our athletic accomplishments, but they also harbor deep suspicions about our costs, our integrity, and even our intellectual aspirations and commitments.

Beyond the classic triad of teaching, research, and service, society has assigned to the University over the past several decades an array of other roles:

- improving health care
- national security
- social mobility
- parenting
- big-time show biz (intercollegiate athletics)

It is now asking to us to assume additional roles such as:

- revitalizing K-12 education
- improving race relations in America
- rebuilding our cities
- securing economic competitiveness

Unfortunately, most folks--and most components of the federal government--can picture the university "elephant" only in terms of the part they can feel, e.g., research procurement, student financial aid, and political correctness. Few in Washington seem to see, understand, or appreciate the entirety of the university. No one seems to understand or care that shifting federal priorities, policies, or support aimed at one objective or area will inevitably have an impact on other roles of the university. For example, it is clear that excessive cost-sharing requirements or inadequate reimbursement of research

overhead costs will inevitably cause the shifting of funds from other functions of the university such as education or public service.

### *Human Resource Issues*

Research is an intensely people-dependent activity. No matter how much funding we have, no matter how fine our facilities, no matter how effective our organizations, if we do not have great people going into these fields, we will not have great research.

For the past decade the National Science Board has been attempting to assess the scientific and technical personnel needs of our nation. It is our belief that we will face serious shortages at both the B.S. and Ph.D. levels by the end of this decade. Studies by Bowen and colleagues suggest that such shortages will appear across many academic disciplines. Most universities can tell you that the faculty crisis is already upon us in many fields--although people in Washington continue to argue around the fringes, debating "shortfalls" versus "shortages" and questioning the assumptions in various manpower projections, while the universities and corporate America suffer, and the clouds continue to build on the horizon.

It is true that we may get a momentary respite from the shift of scientists and engineers from the defense effort into civilian R&D or from scholars emigrating from the collapsing Soviet states. But this will be short-lived. There are clear trends suggesting we may face some serious problems over the longer term:

- i) the declining number of college-age citizens
- ii) the declining fraction of students majoring in basic disciplines
- iii) the limited number of U.S. citizens obtaining doctoral degrees

- iv) the surge of faculty retirements anticipated in 1990s
- v) the probable growth of industrial jobs requiring advanced degrees
- vi) the appalling failure of K-12 science education

Beyond the question of numbers is the question of quality. We have to face the fact that our best students are simply not attracted to research or academic careers these days. Instead, they are attracted to careers in law, business, politics--to wealth, power, and fame--and not to intellectual excitement. As I suggested earlier, it just isn't as much fun to be a faculty member these days, and our students sense this. Clearly the faculty of today feels stressed out--overloaded from the rigors of grantsmanship, paperwork, committee assignments, review panels, oversight strains--with precious little time left over for teaching and research, much less thinking.

We need to address these human resource challenges, or we can forget the rest of the agenda.

### *Paradigm Shifts*

Let me suggest that beyond the financial pressures and human resource concerns, and the difficulties in comprehending and balancing the many missions of the university, there is yet another important theme that we must consider, and that is change itself. Today we find ourselves in the midst of two simultaneous paradigm shifts: i) in the nature of the government-university research partnership and ii) in the character of the university itself. These shifts are being driven by the extraordinary nature and pace of change in the world today.

Let me consider each, in turn.

### **The Transition from Partnership to Procurement**

As we have already noted, the basic structure of the academic research enterprise of the past half century was set out in Bush's study, "Science, the Endless Frontier," almost fifty years ago. The central theme of the document was that the nation's health, economy, and military security required continual deployment of new scientific knowledge and that the federal government was obligated to ensure basic scientific progress and the production of trained personnel in the national interest. It insisted that federal patronage was essential for the advancement of knowledge. It stressed a corollary principle--that the government had to preserve "freedom of inquiry," to recognize that scientific progress results from the "free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for explanation of the unknown."

Since--at least in the past--the government recognized that it did not have the capacity to manage effectively either the research itself or the universities, the relationship was essentially a partnership, in which the government provided relatively unrestricted grants to support a part of the research on campus, with the hope that "wonderful things would happen." And they did, as evidenced by the quality and impact of academic research.

Unfortunately, in recent years the basic principles of this extraordinarily productive research partnership have begun to unravel, so much so that today this relationship is rapidly changing from a partnership to a procurement process. The government is increasingly shifting from being a partner with the university--a patron of basic research--to becoming a procurer of research, just like other goods and services. In a similar fashion, the university is shifting to the status of a contractor, regarded no differently from other government contractors in the private

sector. In a sense, today a grant has become viewed as a contract, subject to all of the regulation, oversight, and accountability of other federal contracts. This view has unleashed on the research university an army of government staff, accountants, and lawyers all claiming as their mission that of making certain that the university meets every detail of its agreements with the government.

To be sure, we must all be concerned about the proper expenditure of public funds. But we also must be concerned about restoring the mutual trust and confidence of a partnership and move away from the adversarial contractor/procurer relationship that we find today.

Unfortunately, even the procurement model may be only a transitional stage, since in recent months there have been signs that the paradigm is continuing to shift still further to the same cost-control--or more correctly, federal cost-shifting--patterns characterizing health care. Can you imagine a system of DRG cost-reimbursement rules for basic research?

Surely the most ominous warning signs for academic research are the erosion, even breakdown, in the extraordinarily productive fifty-year partnership uniting government and universities. Scientists and universities are questioning whether they can depend on the stable and solid relationship they had come to trust and that has paid such enormous dividends in initiative, innovation, and creativity. It is truly perverse that the partnership that has been in large measure responsible for our long undisputed national prosperity and security should be threatened at the very moment when it has become most critical for our future.

## **The Changing Paradigm of the Research University**

There is an even more profound transformation occurring: that involving the paradigm of the research university itself. The triad mission of the university as we know it today--teaching, research, and service--was shaped by the needs of an America of the past. Today our nation and our world are changing at an ever-accelerating pace. It seems appropriate to question whether our present concept of the research university--developed largely to serve a homogeneous, domestic, industrial society of the twentieth century--must also evolve rapidly if we are to serve the highly pluralistic, knowledge-intensive world nation that will be the United States of the twenty-first century.

Given the pace and magnitude of change today, perhaps the decade ahead is a time for "reinventing" the American university. But will a gradual evolution of our traditional paradigm be sufficient? Or will the challenges ahead force a more dramatic, indeed revolutionary, shift in the paradigm of the contemporary research university? While the pace and impact of these changes is still dimly understood, much of the energy on our campuses today is really part of a process to discover the nature of the university of the twenty-first century, an institution that will almost certainly be as different from what we know today as the modern research university is from of the nineteenth century private college.

## **A World Transformed**

Of course these paradigm shifts are being driven by the extraordinary pace of change in our society. We are living in the most extraordinary of times: the collapse of communism, the end of the cold war, the impact of technologies ranging from computers and telecommunication to biotechnology, a redefinition of the world economic order, and, of course, mankind push-



ing against the very limits of the planet. Many believe that we are going through a period of change in our civilization just as momentous as that which occurred in earlier times such as the Renaissance or the Industrial Revolution--except that while these earlier transformations took centuries to occur, the transformations characterizing our times will occur in a decade or less! I used to portray the 1990s as the countdown toward a new millennium, as we find ourselves swept toward a new century by these incredible forces of change. The events of the past year suggest that the twenty-first century is already upon us--a decade early!

Are we ready for it? Are we prepared to face a world whose economy, culture, and polity are driven by the explosion of knowledge itself?

### **Is It Time to Break the Mold?**

This time of great change, of shifting paradigms, provides the context in which we must consider the changing nature of the academic research enterprise itself. We must take great care not to simply extrapolate the past and instead examine the full range of possibilities of the future.

Here we face a particular dilemma. Both the pace and nature of the changes occurring in our world today have become so rapid and so significant that our present social structures--in government, education, the private sector--are having increasing difficulty in even sensing the changes, although they certainly feel their consequences. They are simply incapable of understanding the profound changes characterizing our world, much less responding and adapting in an effective way.

Let me go further. It may well be that our present institutions, such as universities and government agencies, which have been the traditional structures for intellectual pursuits such as research, could be as obsolete and irrelevant to our future as the American corpora-

tion of the 1950s. We need to explore new social structures capable of sensing and understanding change, as well as capable of engaging in the strategic processes necessary to adapt or control change.

### **An Example**

Let me give you an example. Since the business of the academic research enterprise is knowledge, let me suggest that the impact of the extraordinary advances in information technology could have--and likely will have--major implications. Technologies such as computers, networks, HDTV, ubiquitous computing, and knowbots may well invalidate most of the current assumptions in thinking about the future nature of the research enterprise.

Some provocative questions illustrate the point:

Will the "university of the twentieth century" be localized in space and time, or will it be a "meta-structure" involving people throughout their lives, wherever they may be on this planet--or beyond?

Is the university's traditional focus on producing specialists really necessary--or even relevant--in a future in which the most interesting and significant problems will require "big think" rather than "small think," where intelligent software agents can roam far and wide through robust networks containing the knowledge of the world and instantly and effortlessly extract whatever a person wishes to know?

Will lifestyles in the academy (and elsewhere) become increasingly nomadic, with people living and traveling where they wish, taking their work and their social relationships with them?

In the spirit of these questions, perhaps we

should pay far more attention to evolving new structures such as the "collaborator" proposed by Joshua Lederberg rather than traditional structures such as research universities; federal research laboratories; and research projects, centers, and institutes. There is a possible implication here. If information technology will allow--perhaps even require--new paradigms for research organizations, should we not place a higher priority on linking our scientists and engineers, not to mention linking them with the rest of the world? This would seem to be a modest investment compared to other megaprojects such as the SSC and the space station. Without investigating the impact of such an information technology-based infrastructure first, we may find ourselves making massive investments in research structures of the past.

### Concluding Remarks

The world and the structure of academic research have changed greatly since Vannevar Bush wrote his report. However the major principles he advanced merit reaffirmation. Now more than ever before the national interest calls for an investment in human and intellectual capital. As Bush so clearly stated it, the government-university partnership is not simply about the procurement of research results. It is also about nurturing and maintaining the human strengths of a great technological nation and sowing the seeds of innovation that will ultimately bear fruit in new products and processes to fuel our economy and improve our quality of life.

Within the past year, there have been several initiatives aimed at re-examining the nature and health of the American research enterprise. For example, there are currently underway several blue ribbon studies aimed at determining the health of the research university: i) the PCAST (President's Council of Advisors on Science and Technology) study co-chaired by David Packard

and Harold Shapiro, ii) the FCCSET (Federal Coordinating Council on Science, Engineering, and Technology) study chaired by David Kearns, and iii) the GUIRR (Government-University-Industry Research Roundtable) study chaired by Bill Danforth. In late summer, the National Science Board commissioned a major new study to re-examine the premises of the original Vannevar Bush report and the role of the National Science Foundation, in light of the extraordinary changes occurring in our nation and the world. All of these studies are scheduled for completion by late fall, thereby laying the foundation for action in the next administration. But more is required.

The American public, its government, and its universities should not surrender the long-term advantage of this research partnership because of a short-term loss of direction or confidence. At a time when many of society's other institutions do not seem to be working well, the research university is a true success story. We simply must get that message across to the American public. We must re-articulate and revitalize the remarkably successful partnership that has existed between our government, our society, and our research universities over the past four decades.

Indeed, the world--and the structure of R&D--has changed a great deal since Bush wrote his report. But the major principles he advanced in it merit reaffirmation. The long-term national interest still calls for investment in the human and intellectual capital that are essential, ultimately, to national prosperity and security.