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Ann Arbor Rotary, January 24, 1996
"The Government-University Research Partnership: Beyond the Endless Frontier . . .?

Introduction

I believe this is the 8th or 9th time I have been invited to speak to your Rotary group.

This time I am going to do something a bit different...I'm going to set aside my hat as UM president, and instead speak from the perspective of a member and past chair of the National Science Board, the nation's leading body for the development of science policy.

And, from that perspective, I would like to share with you some of my thoughts and concerns about that most extraordinary of species in higher education, the American research university.

John Deutsch: The research university is probably the most endangered species of academic institution over the next decade as the FS&T budget shrinks by perhaps as much as 30%.

One of the unique characteristics 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 between unversities and the society they serve goes back over two centuries to the Northwest Ordinance, which states:

"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 our nation's most
remarkable social inventions, the American research university.

Because they added the activities of research and service to the traditional
academic mission of teaching the young,
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 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 about
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 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, said when he testified before Congress:

> "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."

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.

A couple of years ago 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".

In fact, at a recent session of the National Science Board led by
Nobel Laureate Economist Bob Solow, and involving Laura Tyson's
economic team,
it was noted that in our increasingly knowledge-intensive society,
the rate of return of research is rising.

More specifically, while the average rate of return on capital investment
in the United States today ranges from 10% to 14%,
the private rate of return of R&D investment
is estimated to be 25% to 30%, and
the social rate of return—that is the rate that accrues to society more
generally, is estimated to be as high as 50% to 60%—roughly
four times the rate for other types of investment.

The Bad News

If the good news is that our research universities
are the strongest in the world—at a time when the benefits

from R&D investment have never been higher—the bad news is that the 1990s stand a good chance of being the worst for higher education since the 1930s.

A frightening sense of crisis is gripping 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.
Some 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 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 need
to obtain and manage sponsored research funding.
Another factor is the disintegration of the notion of a
"scholarly community" within the university.

In a recent series of campus workshops
sponsored jointly by the Government-University-Industry Research
Roundtable and the National Science Foundation,
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 (the Forrest Gump syndrome).

Unfortunately, many scientists, universities, and university administrators have made themselves easy targets by their arrogance and elitism.

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

Stresses on the Academic Research Enterprise

Universities are suffering the consequences of the structural flaws of our 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.

For too long the electorate has had the 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.

Today, in Washington, this slogan has been replaced by a new mantra,
"Balance the Budget by the year 2000,"
that is being chanted over and over again as the way to deliverance.

While the particular Tao, the path to deliverance, is still uncertain. . .whether
via the Contract with America or Reinventing Government
. . .the endpoint is clear.

Discretionary domestic spending, research and education programs, and
federal support of the research university, all are at great risk.
(For example, basic research is proposed to decline by 30%, with even the
National Science Foundation being cut up to 13% ($440 M).)

Indeed, leaders both in the federal government as well as in higher education,
have suggested that the next several months could well determine
whether the research university
will survive into the next century
as a viable paradigm in American higher education.

The states are also in serious trouble.
Cost shifting from the federal government through
unfunded mandates such as Medicare, ADA, and OSHA,
the commitment many states have made to funding K-12 education
off-the-top, and
massive investments in corrections have undermined

their capacity to support higher education.

In fact, in many states today, appropriations for prisons
have now surpassed the funding for higher education and
show no signs of slowing.

Few, indeed, are those public universities that can expect even inflationary
increases in state appropriations in the decade ahead.

The Real Issue: Shifting Paradigms

Let me suggest that beyond the financial pressures,
the cost-shifting trends,
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 Changing Nature of the Government-University Partnership

A Shift in National Priorities: From Guns to Butter...

For almost half a century, the driving force behind
many of the major investments in our national infrastructure
has been the concern for national security in the era of the Cold War.

The evolution of the research university, the national laboratories,
the interstate highway system, our telecommunications systems and
airports, the space program . . . all were stimulated by concerns about the
arms race and competing with the Communist Bloc.

So too, much of the technology that we take for granted, from semiconductors
to jet aircraft, from computers to composite materials,
all were spin-offs of the defense industry.

Yet in the wake of the extraordinary events of the last five years—the
disintegration of the Soviet Union and Eastern Europe,
the reunification of Germany, and
the major steps toward peace in the Middle East—the driving force of
national security has disappeared, and along with it,
much of the motivation for major public investment.

The "peace dividend" has not provided new resources in
a post-Cold War world for investment in key areas such as education and
research.

Instead, the nation is drifting in search of new driving imperatives.

While there are numerous societal concerns
such as economic competitiveness,
national health care,
crime, and
K-12 education,
none of these has yet assumed an urgency sufficient
to set new priorities for public investments.

Further, much of the existing intellectual infrastructure,
developed to underpin national defense, is now at risk.

The national laboratories are facing massive downsizing and necessarily
searching for new missions.

The burdens of the massive debts incurred in the buyout-merger mania of the
late 1980s have forced corporate America
to downsize research and development activities,
including the shift of many of America's leading corporate research
laboratories such as the Bell Laboratories and
the IBM Research Laboratories from long-term research
to short-term product development.

Equally serious are signs that the nation is no longer willing
to invest in research performed by universities,
at least at the same level and with a similar willingness
to support understanding-driven basic research.

The federal government has yet to develop a successor to the
government-university research partnership
that served so well during the Cold War years.

A Change from Partnership to Procurement

As I noted earlier, 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 50 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.

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 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 of 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 each detail of its agreements with the government.

Of course we all need to be concerned about how public funds are spent.

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 experience today.

Unfortunately, even the current 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 productive 50-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

An even more profound transformation is occurring:
that involving the paradigm of the research university itself.
As one of civilization's most enduring institutions,
the university has been extraordinary in its capacity to change and adapt to serve society.

Far from being immutable, the university has changed over time and
continues to do so today.

A simple glance at the remarkable diversity of institutions comprising higher
education in America demonstrates this evolution of the species.

The challenges and changes facing higher education in the 1990s
are comparable in significance to two other periods of great change

for American higher education:
the period in the late-19th century,
when the comprehensive public university first appeared, and
the years following World War II,
when the research university evolved to serve the needs of postwar America.

Today, many are concerned about the rapidly increasing costs of quality education and research during a period of limited resources,
the erosion of public trust and confidence in higher education, and
the deterioration in the partnership between the research university and the federal government.

However, our institutions will be affected even more profoundly
by the powerful changes driving transformations in our society,
including the increasing ethnic and cultural diversity of our people;
the growing interdependence of nations; and
the degree to which knowledge itself has become the key driving force in determining economic prosperity, national security, and social well-being.

One frequently hears the primary missions of the university referred to in terms of teaching, research, and service.

But these roles can also be regarded as simply the 20th century manifestations of the more fundamental roles of creating, preserving, integrating, transmitting, and applying knowledge.

While these fundamental roles of the university do not change over time, the particular realization of these roles do change—and change quite dramatically, in fact.

The challenge of change, of transformation, is, in part, a necessity simply to sustain our traditional roles in society.

Beyond the Endless Frontier

In recent months, there have been strong indications that a new federal R&D policy might be taking shape. First, in a recent report by the National Academy of Sciences, chaired by Frank Press, there was a strong call for a more coherent and strategic budgeting policy for that fraction of the federal budget that expands fundamental knowledge and creates new technology. This amounts to some $35 B to $40 B, distributed among federal laboratories (39%), academic institutions (31%), industry (21%), and other institutions (9%). They proposed that this aggregated federal science and technology budget (FS&T) be identified both by the White House and by Congress to provide a more strategic budgeting process. This would allow selective reductions and increases within and across agencies to reflect changing missions and performance evaluations.

The preface to Science and Engineering Indicators, released every two years by the National Science Board, reinforces and expands this theme in three areas:

1) First, it recommends that R&D priorities be set consistent with new scientific opportunities, post-Cold War national goals, and unavoidable resource limtations. Presidential and Conbgressional policy-makers should institute a budget making process which enables them to pay carefuly attention to the complex connections and mutual dependencies among US R&D performers and users, to weight the long term consequencies of specific funding decisions, and to strategically coordinate federal choices and tradeoff. In order to take advantage of valuable world resoruces, both material and human, and to share costs, federal policy makers should pursue international S&T cooperation where possible to achieve national and global goals. In establishing strategic goals for federal reserach investments and principles for setting R&D funding priorities, policy-makers should strive for performance at a world level in all major areas of science and engineering and preeminence in a select number of fields.

2) In addressing current and future US workforce training needs, beginning with universal basic science and mathematics literacy and continuing through to the steady renewal and upgrading of US scientific and technological human resource capacities. Federal R&D policies should explcityly consider the efects of fudning decisions on the evolving partnerships etween federal agencies and laboraties, industry, universities, and schools in order to breaoden systemic educational reform initiatives designed to meet K-12 students' learning needs in mathematics, science, and technology. Federal R&D policies should explicitly consider the differential effects of agencies' funding decisions on the scope and level of support for undergraduate and graduate education in speciic S&E disciplines.

3) The integration of research and education at US colleges and universities should be strengthened. The combination of training and research in US universities has been a major factor in creating scientific and technical preeminence as well as in providing competent professionals to staff industry and government. It is one of the most effective means of technology transfer, and government allocation criteria in the future should recognize this level of achievement. The federal government should strengthen efforts to promote the integration of reserach and education and support innovative experiments in this area.

Back to the Future...

For the past half-century, the Bush paradigm of federal patronage of investigator-driven research has determined the nature of the research university. Only 125 of the 3,600 institutions of higher education are research universities.

It is probably about as safe to assume that the dominate higher education institutions of the 21st century will stem from this small but powerful group of present day institutions as it would have been to assume that today's dominate life form on Earth would stem from Tyrannosaures Rex.

There are some obvious responses to this precarious situation:

1. Universities must shift from the public to the private sector for support (...a no-brainer...)

...loss of 30% in FS&T

...corporate support for R&D

...more aggressive marketing of services

...state support --> tuition ("user fees") ("state-related" universities)

Note that this will require a sea-change in university attitudes

2. From "faculty centered" to "student-centered" activities...that is, from "provider-centered" to "customer-market".

3. From "elitism" and "excellence" to the provision of cost-competitive, high quality services--from "prestige-driven" to "market-driven" philosophies.

Let me focus a bit on this third issue. It seems clear that a shift is now occurring in public attitudes toward research universities. For the past half-century, the Bush paradigm characterizing the government-university research partnership has been one built upon the concept of relatively unconstrained patronage. That is, the government would provide faculty with the resources to do the research they felt was important, in the hopes that at some future point, this research would benefit society. Since the quality of the faculty, the programs, and the institution was felt to be the best determinant of long term impact, academic excellence and prestige were valued.

Yet, today the public seems reluctant to make such a long term investment. Rather, it seems interested in seeking short term services from universities, of high quality, to be sure, but with cost as a consideration. In a sense, it seeks low-cost, quality services rather than prestige.

Perhaps rather than moving ahead to a new paradigm, we are in reality returning to the paradigm that dominated the early half of the 20th century...the "land-grant university" model. In fact, perhaps what is needed is to create a contemporary land grant university paradigm.

When the Morrill Act was adopted in 1862, it was aimed at establishing programs in agriculture, mining, and the mechanic arts--the forerunner of today's schools of engineering. The industrialization of our nation was the objective and Europe our competitor. That we were successful is obvious. The vast natural resources of our country produced immense wealth for some and a higher standard of living for most. The agricultural experiment stations and cooperative programs were enormously successful. In the last century our universities, particularly land grant institutions, created and applied knowledge, and provided human resources needed to address critical national problems defined by Congress. yet, apart from World War II and the Cold War periods' focus on defense as our national priority, Congress has not found it possible to identify, prioritize, and support an agenda of national needs in any sustained fasion. if we cannaot work on a national agenda, perhaps we should adopt a regional approach.

A land grant university for the next century could be designed to develop our most important resource, our human resources, as its top priority. The field stations and cooperative extension programs could be directed to the needs and the development of the people in the region. While traditional professional fields would continue to have major educational and service roles and responsibilities, increasingly, new interdisciplinary fields should

be developed to provide the necessary knowledge and associated problem-solving services in the land grant tratdition.

Concluding Remarks

There is an increasing sense among leaders of American higher education and on the part of our various constituencies

that the 1990s will represent a period of significant change on the part of our universities if we are to respond to the challenges, opportunities, and responsibilities before us.

A key element will be efforts to provide universities with the capacity

to transform themselves into entirely new paradigms that are better able to serve a rapidly changing society and a profoundly changed world.

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 corporation 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.

If American higher education is to respond to the challenges, opportunities,
and responsibilities before us,
universities must develop the capacity to transform themselves
into entirely new paradigms
that can serve a rapidly changing society and a changed world.

We must unshackle the constraints that prevent our institutions from
responding to the needs of a rapidly changing society,
remove unnecessary processes and administrative structures,
question existing premises and arrangements, and
challenge, excite, and embolden members of our university communities
to embark on this great adventure.

Our challenge is to provide an environment in which such change
is regarded not as threatening but rather as an exhilarating opportunity
to engage in learning, in all its many forms, to better serve our world

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.

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.

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.