Welcome and Opening Comments

Plenary Session

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On behalf of the National Science Board, welcome to this second convocation concerned with the nature of the stresses on research and education in American higher education. Let me convey my particular gratitude to Governor Richard Celeste and the Government-University-Industry Research Roundtable and to Bruce Alberts and the National Academy of Sciences for their strong efforts in making possible both the campus-based dialogue and this national convocation.

As you recall, this effort was stimulated several years ago when Roland Schmitt, then chair of the National Science Board, observed that despite the relatively generous federal funding of academic research during the 1980s, faculty morale on our campuses appeared to be at an all-time low. A series of informal workshops revealed the usual litany of concerns:

- Fears about the future funding of research
- The stresses of grantsmanship
- The loss of a sense of scholarly community with increasing specialization
- The imbalance between the rewards for research vs. teaching
- A host of technical issues, such as indirect costs, facilities support, government reporting and accountability requirements, and so on

Yet, in the first round of the more structured discussions that were sponsored by the National Science Board (NSB) and the Government-University-Industry Research Roundtable (GUIRR) across the nation, it became clear that the stresses were driven by an array of more fundamental forces, all of which could be captured in a single word: *change*. Rapid and profound change is occurring in our world, our society, and consequently in our social institutions. Our universities are feeling the stresses of these forces of change.

The Challenge of Change

There are many ways to group the challenges of change in higher education. For our purposes today, let me suggest the following framework:

A political-economic crisis: All 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 social institutions as governments struggle to meet short-term demands at the expense of long-term investment. The traditional public principle has been that education is a public good that benefits all of society and hence should be supported by society-at-large. There is a growing sense that this principle is being replaced by a view of education as a private good that should be paid for by those benefiting most directly—the students.

Cost shifting among stakeholders: Each of the many stakeholders of the contemporary university—students and parents, state and federal government, business and industry, the public-at-large—wants to

minimize the resources it provides and maximize the services it receives from our institutions. Today few seem to be able to see the university and its diverse missions as a whole. More specifically, each constituency seems to want much more out than it is willing to put in, thereby leveraging other contributors.

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. As concerns about national security have ebbed in the wake of the geopolitical restructuring of recent years, 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.

A change from partnership to procurement: In recent years the basic principles of the extraordinarily productive partnership between the federal government and America's universities in support of research and advanced training has begun to unravel, so much so that today this relationship is rapidly changing from a partnership to a procurement process. 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 the scientific and technological strength of our nation.

A shift in attitudes toward teaching and research: In recent years, there has been a decided shift in public attitudes toward the purpose of a university, away from research and toward undergraduate education. A several decade-long public consensus that universities were expected to create as well as transmit knowledge, a consensus that supported strong investment in the scientific, technological, and scholarly preeminence of this nation, has begun to erode.

Politics: Most of America's colleges and universities have more than once suffered the consequences of ill-thought-out efforts by politicians to influence everything: what subjects can be taught, who is fit to teach, and who should be allowed to study or teach. The special interest politics of our times, with a decidedly slash-and-burn character, are increasingly focusing on higher education. In the past, our universities were buffered from politics both by their governing boards and the media. Today, however, these groups now serve to focus and magnify political attacks on our campuses, rather than shielding us from them.

Deteriorating ability to lead: A recent study by the Association of Governing Boards has concluded that one of our greatest challenges is the weakness of the contemporary university presidency. They found that the authority of university presidents had been undercut by all of their partners—trustees, faculty, and political leaders—and, at times, by the

president's own lack of assertiveness and willingness to take risks for change.

Such challenges suggest that the status quo is no longer an option. But, of course, change is no stranger to the university. American higher education has always been characterized by a strong bond with society, a social contract. As society has changed, so too have our institutions changed to continue to serve.

The American university has responded quite effectively to the perceived needs—or opportunities—of American society. A century ago our universities developed professional schools and rapidly transformed themselves to stress applied fields, favored by the federal land-grant acts, such as engineering, agriculture, and medicine. In the post-World War II years, they responded again, expanding to absorb the returning veterans and later the postwar baby boom. They then developed an extraordinary capability in basic research and advanced training in response to the evolving government-university research partnership.

Our workshops reveal that this process of evolution continues on our campuses today. There is strong evidence that our universities are positioning themselves to respond to a new array of national needs:

- Sustaining the economic competitiveness of industry
- Providing affordable, high-quality health care
- Becoming more involved with K-12 education and lifelong learning
- Addressing needs for greater equity and access
- Developing new partnerships and alliances, both among themselves and with government and industry, as they reach out to better serve society

The workshops also revealed the great level of activity within our colleges and universities to better position themselves for a time of constrained resources:

- Restructuring, reengineering, and streamlining of organizations, processes, and procedures
- Cost-containment and total-quality management
- Focusing resources on our core competency: learning

A Changing Enterprise

But there are more fundamental forces of change at work here: change in our mission, in our relationship with society, in the nature of our institutions, and in the higher education enterprise more broadly.

Changes in Mission

It is common to refer to the primary missions of the university in terms of the trinity 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. From this more abstract viewpoint, it is clear that while these fundamental roles of the university do not change over time, the particular realizations of these roles do change—and change quite dramatically, in fact.

Consider teaching, for example, where there are signs that the classroom form of pedagogy may soon be replaced by new learning paradigms more suited to the "digital" generation. Today's students have spent their early lives surrounded by robust, visual, electronic media, approaching learning as a "plug-and-play" experience, unaccustomed and unwilling to learn sequentially—to read the manual—and inclined instead to plunge in and learn through participation and experimentation. While this type of learning is far different from the sequential, pyramid approach of the traditional university curriculum, it may be far more effective for this generation, particularly when provided through a media-rich environment.

It could well be that faculty members of the 21st Century university will be asked to set aside their roles as teachers and instead become designers of learning experiences, processes, and environments. Further, tomorrow's faculty may have to discard the present style of solitary learning experiences, in which students tend to learn primarily on their own through reading, writing, and problem solving. Instead, they may be asked to develop collective learning experiences in which students work together and learn together with the faculty member becoming more of a consultant or a coach than a teacher.

The process of creating new knowledge—of research and scholarship—is also evolving rapidly away from the solitary scholar to teams of scholars, perhaps spread over a number of disciplines. In a world of robust knowledge networks and intelligent software agents, one might also question whether there will be in increasing shift away from focused specialization to broader, generalist approaches to scholarship.

The preservation of knowledge is one of the most rapidly changing functions of the university. The computer—or more precisely, the "digital convergence" of various media from print-to-graphics-to-sound-to-sensory experiences through virtual reality—has already moved beyond the printing press in its impact on knowledge. Throughout the centuries, the intellectual focal point of the university has been its library, its collection of written works preserving the knowledge of civilization. Yet, today, such knowledge exists in many forms—as text, graphics, sound, algorithms, and virtual reality simulations—and it exists almost literally in the ether, distributed in digital representations over worldwide networks, accessible by anyone.

Changes in Relationships with Society

It is also clear that societal needs will continue to dictate great changes in the roles and relationships of the university. Over the past several decades, universities have been asked to play roles in applying knowledge across a wide array of activities, from agriculture to health care, from national security to protecting the environment, from rebuilding our cities to entertaining the public at large (intercollegiate athletics).

Yet, as important as universities are today in our everyday lives, it seems 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."

Changes in Our Institutions

The complex and heterogeneous nature of American society has given rise to a system of higher education of extraordinary diversity. From small colleges to big universities, from religious to secular institutions, from single-sex to co-educational colleges, from vocational schools to liberal arts colleges, from land-grant to urban to national research universities, there is a rich diversity, both in the nature and the mission of America's roughly 3,600 accredited colleges of higher education. These factors not only lead to great diversity in the character of institutions, appropriate for a highly diverse society. They also lead to a remarkable diversity in how institutions respond to a changing society.

Today, we see signs that this evolution of the species is continuing. "Open universities" based upon distance-learning paradigms have been common throughout the world for decades. The rapid evolution of information technology is making possible a new class of institution, the "virtual university," an institution without walls—and perhaps even without faculty—capable of providing education anytime, anyplace at modest cost. As higher education breaks away from the constraints of space and time—and as the needs for advanced education in a knowledge-driven civilization become more intense—there are already signs that a new class of global universities is forming.

Changes in the Enterprise

Today higher education is evolving from a loosely federated system of colleges and universities serving traditional students from local communities to, in effect, a global *knowledge industry*. With the emergence of new competitive forces and the weakening influence of traditional regulations, it is evolving like other "deregulated" industries, e.g., communications or energy. It is strongly driven by changing technology. And, as our society becomes ever more dependent

upon new knowledge and educated people— upon "knowledge workers"—the higher education business must be viewed clearly as one of the most active "growth industries" of our times.

One of most significant features of a deregulated knowledge industry will be its challenge to the traditional monolithic, vertically integrated structure of the contemporary university. As universities are forced to evolve from "faculty-centered" to "learner-centered," they may well find it necessary to unbundle their many functions, ranging from admissions and counseling to instruction to certification.

Higher education today is one of the few activities that has yet to evolve from the handicraft, one-of-a-kind mode of a cottage industry to the mass production enterprise of the industrial age. In a very real sense, the industrial age has largely passed by the university. Faculty continue to organize and teach their courses much as they have for decades—if not centuries. So, too, our societal institutions for learning—schools, colleges, and universities—continue to favor programs and practices based more on past traditions than upon contemporary needs.

Yet, it may be quite wrong to suggest that higher education needs to evolve into a mass production or broadcasting mode to keep pace with our civilization. Fortunately, today's digital technology is rapidly breaking the constraints of space and time. Through computers, networks, and new *asynchronous learning* technology, we have the capacity to provide quality education anytime, anyplace, to anyone. The barriers are no longer cost or technology but rather perception and habit.

But even this may not be enough. Instead of asynchronous learning, perhaps we should instead consider a future of *ubiquitous learning*—learning for everyone, every place, all the time. Indeed, in a world driven by an ever-expanding knowledge base, continuous learning like continuous improvement has become a necessity of life. To prepare for "an age of knowledge," perhaps we should aspire to build a "culture of learning," in which people are continually surrounded by, immersed in, and absorbed in learning experiences.

Concluding Remarks

It is this time of great change, of shifting paradigms, that provides the context in which we must consider the changing nature of the academic research enterprise. We must take great care not simply to 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, and the private sector—are having increasing difficulty in even sensing the changes, although they certainly feel their consequences. They are unable to understand the profound changes

characterizing our world, much less responding and adapting in an effective way.

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 education research, could be as obsolete and irrelevant to our future as is the American corporation of the 1950s. Perhaps we need to explore new social structures capable of sensing and understanding change, as well as of engaging in the strategic processes necessary to adapt or control change.

Perhaps it is time to explore entirely new paradigms of learning—and learning institutions—that may be required to serve a changing society and a changing world in the century ahead. Perhaps the greatest stress of all on the academy—but still unspoken—has to do with the very viability of the research university as we know it in the next millennium.

For the past half a century, national security was America's most compelling priority, driving major pubic investments in social institutions such as the research university. Today, however, in the wake of the Cold War and on the brink of the age of knowledge, one could well make the argument that education will replace national defense as the priority of the 21st Century. Perhaps this will become the new social contract that will determine the character of our educational institutions, just as the government-university research partnership did in the latter half of the 20th Century. We might even conjecture that a social contract, based on developing the abilities and talents of our people to their fullest extent, could well transform our schools, colleges, and universities into new forms that would rival the research university in importance.

It is this time of change that provides the content for our dialog today. It is important that we discuss these issues together, as faculty and university administrators and as universities, government, and industry. We should explore how we can work together to change so that we can continue to serve. We must seek new levels of understanding, accountability, and flexibility if we are to transform the stresses and challenges of change into the opportunities for the future.