

Testimony of Dr. James J. Duderstadt

Mr. Chairman, members of the Committee, thank you for this opportunity to speak with you today. Before we begin, let me note that we have already responded in writing to your questions addressed to all universities. In addition, Provost Whitaker and I will be glad to respond to your questions and comments following our presentation.

It is traditional for most of us to put before you the depressing facts and figures that spell out the mounting fiscal crisis facing Michigan's public colleges and universities.

Many of my colleagues from Michigan's other universities have already come to tell you of their escalating need for financial aid; of postponed innovations and renovations; of leaking roofs; of outdated facilities and equipment; of the financial stress borne by our students and their families; of the need to replace retiring faculty. These are just some of the signals of distress coming from the front lines where our public universities struggle to maintain quality and to keep open the door to educational opportunity despite reduced state funding. This is the same grim message you received from us last year, and the year before, and the one before that.

We know that you and your Legislative colleagues on both sides of the aisle, along with the Governor, faithfully struggle to provide as much support as you can to our state's universities. We know you are trying hard to protect Michigan's investments in the future while you also try to meet pressing

demands of our people today. We are grateful for your efforts. However, we also know that the prospects of the state being able to meet the needs of its universities, however urgent or compelling, have never been more bleak.

In higher education we are frustrated--and we know that you are frustrated--by the fact that despite all the combined best efforts of state government and universities, Michigan continues to fall further behind in our ability to support higher education. It is hard to stand by and watch while our universities approach the brink of fiscal crisis and deterioration.

State support of education in Michigan over the past two decades, has fallen from near the top among states to far below the national average.

Higher education, like other state services, must accommodate to the cyclic nature of the Michigan economy. During difficult times, we share the pain of appropriation constraints. While the Governor has been steadfast in his commitment to protect higher education from deep budget cuts, it is also true that over the past decade, we have seen the purchasing power of our state appropriation decline, on the average, by roughly 25%. Hence, during periods when the Michigan economy is more prosperous, it is important for the state to re-invest, to make up for lost ground, or to risk the long term erosion in the capacity and quality of our institutions.

Needless to say, if the Governor's budget recommendation for higher education is adopted, most of our public universities will not see any recovery this year. Rather we will experience year another of steady-state or declining support.

This history of slow erosion of state support of its public universities, now entering its third decade, is a critical issue to Michigan. For this reason, I would like to depart a bit from the tradition of appealing for another percent or two in appropriation this year, and instead build a broader framework to illustrate just what is at stake for the people of Michigan.

First, let me share with you two brief vignettes...

Genetic Medicine

For those of you who are old enough, let me take you back some forty years to the early 1950s. You will probably recall the great fear of most parents of the dreaded disease, polio. At that time, the University of Michigan was conducting the clinical trials of a new vaccine developed by a Michigan faculty member, Jonas Salk, that was destined to eliminate the threat of this disease from our society. Well, today the University is engaged in an even more important quest, destined to change the entire nature of health care itself.

A team of extraordinary medical scientists is applying the new science of molecular genetics to medicine. You may have heard that two years ago they announced the discovery and cloning of the gene responsible for cystic fibrosis. They have gone on to develop a technique to inject normal genetic material into a cystic fibrosis gene and correct the deficiencies. More recently they have discovered the genetic causes behind other diseases such as neurofibromatosis (sometimes called the Elephant Man's disease), a disease that destroys the body's ability to tolerate cholesterol, and this past year they discovered the gene responsible for diabetes. The team is now closing in on identifying the genes responsible for certain forms of breast cancer. The implications of this work are

extraordinary indeed when it is recognized that most of the diseases plaguing our society today are genetic in nature, e.g., cancer, heart disease, high blood pressure. But this is only part of the story.

The University is also one of four sites in the United States engaged in the Human Genome Project, a massive effort aimed at mapping the entire human genetic code. The implications of this effort are extraordinary, since once it is successful, it will allow one to immediately identify an individual's susceptibility to various diseases. In effect, it would shift medicine from therapy to prevention, since such advanced knowledge would allow one to adopt a lifestyle designed to avoid such genetic diseases.

Networking the World

Fortune magazine centerfold...Ann Arbor...

On the University's North Campus is a large glass building, chock-full of computers that in many ways may represent the future of our state. This is the command center of the National Research and Education Network, (NREN), a massive world-wide network operated by the University of Michigan in collaboration with IBM and MCI. It links together the computers on all university campuses and industrial and government laboratories throughout the world. Today the network already links together over four million users world-wide, and it is doubling in size and scope every six months.

In a very real sense, the University of Michigan is playing a lead role in building an interstate highway system of information flow--except in this case the system is world-wide, rather than nation-wide. Why is this so important, aside from the fact that it allows Michigan students, faculty, and staff to collaborate with colleagues around the world? If you think about it, you will realize that the key activity that determined the course of our civilization during the twentieth century was transportation--cars, trains, planes, oil, space. Transportation was the enterprise that determined prosperity, national security, even the nature of our culture, with the growth of the suburbs, international commerce, and so on. A century ago the State of Michigan was well-positioned to play a leadership role in this new range of industries, and through the automobile industry it became one of the most prosperous and powerful regions on earth.

Many believe that the driving theme of the twenty-first century will be communication, enabled by the profound advances we are now seeing in computer technology, networks, satellites, cellular phones, fiber optics, high definition televisions, and so on. In fact, we are evolving toward a world in which hundreds of millions of computers will easily plug into a global information infrastructure. It's probable that the impact of this technology will be far more radical than the harnessing of steam and electricity that led to the industrial revolution in the nineteenth and twentieth centuries. Perhaps it is more akin in impact to the discovery of fire by primitive tribes since it will prepare the way for a revolutionary leap into a new age that will profoundly transform human culture.

Sound improbable? Recent statistics have indicated that in this country over 50 percent of homes already have personal computers, and over 70 percent of workers use computers in their jobs. Indeed, surveys have indicated that over seventy percent of homes with children ages eight to twelve have Nintendo games, which are nothing more than small personal computers.

To some degree we have already felt the impact of this shift from transportation to communication as Michigan's industry has become less competitive and, in many ways, less important to the world order. Yet, through the leadership role of the University, Michigan is once again positioned to play a leadership role in this new arena, to build a new industrial base in information technology that will provide the infrastructure for the communications industries that will dominate the twenty-first century.

What is the University of Michigan, Anyway?

When we hear the words "the University of Michigan," we generally think of those traditional images of any college. Great faculty challenging and exciting students in the classroom; students studying in our many libraries, scientists toiling away late into the evening in our laboratories, striving to understand the universe, scholars poring over ancient manuscripts in our collections of antiquity.

But there are some other very special images of the University of Michigan that come to mind. Ann Arbor on a Saturday afternoon in the fall, as 105,000 fans are packed into Michigan stadium to cheer on the Wolverines. There is also the caring Michigan seen by the over 850,000 patients each year who are

treated by the University of Michigan Medical Center. Some see the University as silicon valley east, working closely with Michigan industry and government to build the high-tech infrastructure, to create new companies and new jobs, and to strengthen and diversify our industrial base.

The University attracts to the state over \$300 million dollars of federal R&D, not to mention many of the world's leading scientists and engineers. It conducts cutting-edge research in a vast array of areas ranging from medical science, such as the effort to develop genetic medicine mentioned earlier, to technology, including the University's discovery of the maser and holography, to national defense, where University laboratories developed synthetic aperture radar and the radar absorbing materials used to construct the stealth fighter, or in the social sciences, such as the Survey Research Center and the Consumer Confidence Poll.

The University also has a long tradition of helping to awaken the conscience of a nation. Student activism led to the teach-ins of the 1960s against the war in Vietnam to Earth Day in the 1970s to raise concerns about the environment and, most recently, to the University's commitment to become a truly multicultural learning community.

Then too, there is Michigan and the arts: the array of cultural events at Michigan is extraordinary and includes many of the great orchestras and performers of the world. To this is added the scores of spectacular student productions, plays, concerts, dances, and operas that have enlivened the campus over the years.

In many ways, Michigan is a university of the world. It has been long renowned as a truly international center of learning, whether it be through our great area studies programs: the China Center, Japanese Studies, Southeast Asian Studies, Russian and Eastern European Studies, or through our alumni throughout the world. Indeed, in many ways Michigan is the university of the universe because of Apollo 15, the Michigan mission to the moon, which not only established the first UM alumni club in space, but named a crater on the moon after Michigan.

The University serves as a unifying force in our families as well through Camp Michigania and all of the various alumni activities.

But, of course, first and foremost, there is Michigan as the educator, attempting to provide, in the words of one of our first presidents, "an uncommon education for the common man," an education as good as any available in the world, an education for all with the ability and will to succeed, regardless of race, creed, and economic background. To that end, we have made major strides in recent years to more accurately reflect the demographic composition of this state, with enrollments of students of color doubling over the past several years to now represent 25% of our student body, and faculty of color rising to 14%.

It is important to note these different perspectives of the University because all too often we tend to think of these marvelous and complex institutions in one-dimensional images that reflect only our particular interests at the moment--when we read about student unrest on our campus or see Colorado beat Michigan with a touchdown bomb as the clock expires or open the tuition bills for our sons and daughters. In fact, perhaps the best way to think of the

University is to recognize that our primary role is to invent the future, through the knowledge discovered on our campuses and the graduates that we educate who can carry forth this knowledge and apply it to serve society.

What do Michigan taxpayers get for their money?

Let me suggest yet another way to look at higher education in Michigan-- in terms of the investment that we each make in it. This past year the taxpayers in the state contributed over \$280 million through state appropriations to the University of Michigan. What did they get in return?

Well, there are certain obvious payoffs. For example, it provided an outstanding education for over 50,000 students including 29,000 undergraduates, 80 percent of them Michigan residents. It also produced 12,000 graduates at all degree levels in all disciplines and professions.

But this investment yielded far more. For example, in comparison to the \$280 million invested by tax payers of the state, the University attracted to Michigan over \$500 million in federal support in the form of sponsored research contracts, student financial aid, and health care. Further, students attracted to our programs contributed another \$400 million in tuition fee payments. In addition, the auxiliary activities of the University, such as its hospitals, residence halls, and athletic teams, contributed another \$1 billion to the state's economy. Added all together, the University's activities generated a \$2.5 billion impact on the state's economy, a multiplying factor almost 10-fold when compared to the taxpayer investment.

But that's not all: it is estimated that the true economic impact of the University multiplies its state appropriation by at least another factor of ten or more. For example, the University's engineering programs are recognized as a key in the recent growth of a \$5 billion industry in industrial automation that has sprung up in the southeastern Michigan area. Each year the University spins off dozens of new companies, creating new jobs and attracting new dollars to our state. Each year the University produces thousands of engineers, scientists, business executives, doctors, nurses, lawyers, teachers, and all of the other professionals so necessary to compete in the knowledge-based economy which characterizes our world.

The Importance of the Research University

It is clear that the public research university, an institution for which the University of Michigan is not only the prototype but perhaps also the flagship, touches the lives of a great many people in a great many different ways. Since World War II our society has assigned to the research university an increasing number of roles, broadening its mission far beyond that of simply producing the educated people needed by our society. Through education, research, and service; through health care, economic development; and yes, even through a sense of pride in athletic accomplishments.

As important as these institutions are today in our everyday lives, it is my belief 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.

A World Transformed

Few of us realize the full implications of the ever-accelerating pace of change in our world, in our nation, and perhaps most of all, in our state. Some of you may have heard me talk frequently about the themes of these changes: a change in population, the globalization of our society and the age of knowledge. These changes are more than just talk--change is transforming our world even as we stand here today. Indeed, one might regard continual change as the only true constant of our age.

Who would have predicted several years ago:

- that Communism would be rejected around the world--swept away by the winds of freedom and democracy;
- that the Berlin Wall would crumble and Germany would be reunified, and Eastern Europe would break away from the Soviet Block to embrace democracy and unite with Western Europe;
- that the Soviet Union and China, together with most of the world's nations, would act together to defeat the actions of an aggressive dictator in the Middle East;
- that the Soviet Union would fly apart from the centrifugal forces of freedom and nationalism;
- that the share of the domestic automobile market held by U.S. auto companies would drop below 50 percent;

- that test tube fertilization would become routine;
- that it would be possible for a person to communicate on a palm-sized cellular phone from any place on the surface of the earth;
- or that Bo Schembechler would become president of the Detroit Tigers.

Yet, all of these events have actually happened, along with so many other events that have changed our state, our nation, and our world.

And these changes are just the tip of the iceberg. Even more profound changes are underway. We are becoming more diverse, more pluralistic as a people. Indeed, almost 85 percent of the new entrants into our work force during the decade ahead will be people of color, women, or immigrants. Further, our population, economy, and commerce everyday are becoming more interdependent with other nations as the United States becomes a world nation, a member of the global village. And we are rapidly evolving into a new post-industrial society, indeed, a "hyper-industrial" society in which the key strategic commodity necessary for prosperity and social well-being has become knowledge itself--educated people and the ideas they produce. Knowledge now plays the same role that in the past was played by natural resources or geographic location or labor pools.

We live in a time of breathtaking change, at a pace that continues to accelerate even as I speak. The reality is that we have entered the twenty-first century a decade early. The new millennium is here today in 1991, and we must be prepared to face a world of extraordinary change given by the explosion of

knowledge itself. Many today believe that a period of change in our civilization is just as profound as that which occurred during the Renaissance, the Age of Discovery, and the Industrial Revolution. Except that while these earlier transformations took centuries to occur, the transformations characterizing our time have been compressed into a decade or less.

Do we know where these changes are leading? What will the world of the twenty-first century be like? All that reasonably can be said is that our world will change more in the next ten years than at any other period of our history. Are we ready for it? Are we prepared to face a world whose economy, culture, and polity is driven by the explosion of knowledge itself?

The Challenges Before Our State

The Challenge of Change

My wife and I have lived in Michigan for almost twenty-five years--we have paid taxes here, we have brought up a family, and we have seen our state go through wrenching changes. In the past our industrial base, our economy, has relied on the fortunes of a few large companies--in fact, one large industry. For most people, there was never any reason to be particularly entrepreneurial or to worry about anything more than occasional uptakes and downturns in the economy. Only during the last decade have many of us begun to understand that the old economy will never return, that even if our traditional industries become more successful, the huge economic base upon which all of our policies were formed will never return.

Michigan is midway through a several decade-long transition from a state dominated by a single industry and a few large companies to one dependent upon tens of thousands of small, dynamic companies competing in a broad spectrum of world markets. We are experiencing a transition from low-skill, high-pay jobs to high-skill, high-pay jobs (or, tragically, low-skill, "no" pay jobs); from a transportation industry state to an information industry state; from the Industrial Age to the Age of Knowledge in which educated people and ideas have become the key strategic commodities determining economic prosperity, national security, and quality of life.

Unfortunately, Michigan is currently not well-positioned to make this difficult transition since over the years our state tax policy, regulatory policy, social services, public investment strategy, and politics have evolved to serve big business, big labor, big government--and, in reality, a single industry. Yet this old alliance--big business, big labor, and big government--is increasingly irrelevant to our future, although we are still propping it up.

The key question then becomes: What is the new alliance that we will build, and which enterprises will comprise it? A look at the past decade provides a hint. Even as we were losing thousands of jobs with the decline of the auto industry, we were also gaining over 200,000 new jobs from thousands of new companies. Professor John Jackson makes a strong point that, despite the doom and gloom of plant closings, Michigan still has a very dynamic economy. Yet, unlike the past, the growth and maturation of these new companies is far more rapid, and they also have shorter life spans, since they are swept along by the rapid pace of

technology. He uses the analogy of a forest, where mature trees gradually fall or are harvested and young saplings grow in their place.

From this perspective it seems clear: we must **restructure** our state to create, attract, and support the tens of thousands of new companies on which our future will depend. We must enable them to function in a rapidly changing, frighteningly competitive, and knowledge-intensive world marketplace. Michigan's challenge is not dissimilar to that faced by industrial corporations, by government, and by universities themselves. We must restructure ourselves to serve the future rather than simply perpetuate the past. From a broader perspective we must restructure our state, our business and industry, our government, and our institutions to prosper in the Age of Knowledge that is already upon us. ■ We must recognize and respond to both the challenges and the opportunities before us.

One Key: Education

One of the strongest beliefs I hold is that the key to economic growth is education, not economic development programs. Education is the only enterprise that will save us from becoming a backwater economy. It is a point of "lift off," from which we can create new markets, processes, and skills.

■ Over the next five years, we must make some hard choices and reform our K-12 system. We are closer to designing a system that lets students, teachers, and parents know what is expected of them--one that uses international benchmarks to compare our schools. But we are still far from getting parents to understand that

there indeed IS a problem, and we are still focused on school finance versus a clear vision of what will make better schools. Michigan children may be able to compete with children from Ohio, but they are far behind children in Tokyo and Beijing. K-12 reform is imperative, and that message must be delivered more forcefully not just in Lansing, but around the state.▣

But there is something else. Even if we are successful in our reform of K-12 education, it is clear that we must make additional investments to create the new jobs that can employ these graduates. These jobs presently do not exist in our state. And that leads me to a second critical area for strategic investment: research and development.

The Second Key: Job Creation in An Age of Knowledge

It is important to realize that increasing the competitiveness of existing industry, while perhaps retaining market share and sustaining profits, will NOT retain jobs (since doing things with less people is a frequently a key to increased productivity). Efforts such as total quality management, shorter cycle times, just-in-time inventory, will not create new jobs but, at best, will only preserve some existing jobs.

Rather, in an Age of Knowledge, new knowledge itself is necessary to create new jobs.

It seems increasingly clear that new jobs in Michigan are not going to be spawned by existing industry but instead will be created by entirely new activities,

e.g., genetic medicine, biotechnology, information technology and computer networking, optics, lasers, ultra-high-speed technology, and automated manufacturing.

From this perspective it is clear that the most powerful economic engines in Michigan may well turn out to be our two great research universities: the University of Michigan and Michigan State University.

Why?

The key ingredients in technology-based economic development are: (1) technological innovation, (2) technical manpower, and (3) entrepreneurs. Research universities produce all three. Through their on-campus research, they generate the creativity and ideas necessary for innovation. Through their faculty efforts, they attract the necessary "risk capital" through massive federal R&D support. Through their education programs they produce the scientists, engineers, and entrepreneurs to implement new knowledge. And they are also the key to knowledge transfer, both through traditional mechanisms, such as graduates and publications, as well as through more direct contributions such as faculty/staff entrepreneurs, the formation of start-up companies, strategic partnerships, and so on.

There is ample evidence to support the impact of world-class research universities. We need only look at MIT's impact on the Boston area, Stanford and UC-Berkeley's impact on Northern California, Caltech's impact on Southern California, and the University of Texas' impact on Austin. But there is an important lesson from these examples. Only world-class research universities are

capable of major impact. A university must be able to play in the big leagues, to compete head-to-head with institutions such as MIT, Stanford, and Berkeley if it is to attract the outstanding faculty and students and massive resources necessary for technological leadership.

Fortunately, the University of Michigan and Michigan State University are already among the best in the world. We can take advantage of the talent and resources that reside in them right now--today! But to do so, we must think and act far more strategically than we have done in the past.

The Strategy

There is already a good deal of evidence about the University of Michigan's impact on local economic development. More than 150 companies can trace their roots to the University in one way or another. In Washtenaw County there are some 148 high-tech firms employing 13,500. These firms are estimated to have created 6,000 jobs and generated over \$11 million in property taxes.

Let me give you a recent example: Three years ago the University established the National Center for Ultrafast Optical Science as one of the NSF Science and Technology Centers, headed by Professor Gerard Mourou. The Center has already spawned three new spin-off companies while developing research collaborations with nineteen companies. It has won five Small Business Innovation Research grants from the NSF and produced six optical products that are already out in the marketplace. Here it should be stressed that the dominant activity in the Center is not applied research but rather the basic exploration of the frontiers of optical science. But this is just the type of new knowledge that generates spin-offs, new companies, and new jobs.

More of this kind of growth can occur if we can successfully transfer the technology at our research universities. In a sense, it is happening with the thousands of University faculty, staff, and student members already involved in technology transfer activities already through publication, conferences, and consulting arrangements. But we would like to take this one step further and develop a strategic plan for creating real, economic growth, with hundreds of small, growing firms clustered around the University of Michigan as an R&D center. The goal we have in mind is nothing less than to make Ann Arbor an economic engine of the Midwest.

Concluding Remarks:

Mr. Chairman, it is clear that our state is in the midst of a profound transition. We are leaving behind our industrial economy, once prosperous due to an abundance of natural resources, unskilled labor, and--to some degree--constrained, slowly moving domestic markets. Instead, our future is clear: Michigan will be characterized by a knowledge-based economy, characterized by intensely competitive world markets, rapid technological change, and--most important of all--its dependence upon educated people and their ideas.

This has not been--and this will not be--an easy transition to make. The truth is that the outcome is still very much in doubt. Will we emerge from this transition as a world economic leader once again, with a strong, prosperous--albeit new--economy producing jobs and improving our quality of life? Or will we fail to heed the warnings, fail to make the necessary investments and sacrifices today necessary for strength and prosperity tomorrow, and instead become an economic backwater in the century ahead.

It is clear that we face a fork in the road ahead. My central theme is that education, broadly defined, will be the pivotal issue in determining which of these two alternative futures will be Michigan's--and America's. Indeed, I am absolutely convinced that the dominant issue of the 1990s will be the development of our human resources. Previous economic transformations were closely associated with major public investment in infrastructure such as railroads, canals, electrical networks, and highways. In the coming economic transition, an equivalent infrastructure will be an educated population. The actions we must take today, and the investments we must make, will clearly determine our capacity to respond to this future.

It is clear also that we must do everything possible to protect our public universities during this transition period, since they will not only be key to our recovery, but key to our prosperity for the long term. We all need to be reminded that it has taken the commitments and sacrifices of eight generations of Michigan citizen's to build these wonderful institutions. It would be tragic indeed if our generation--and your state government--were to drop the baton and allow the quality of these institutions to be destroyed.

However let me also acknowledge, as I am certain that we are all very painfully aware, that there is very little positive that state government can do to help higher education over the next several years. Until you complete the restructuring of state government and until Michigan's economy rebounds, you simply will not have the resources.

Hence, during this period, it will be the institutions themselves which must take internal actions necessary to preserve their quality and capacity to serve the state during a period of extreme financial hardship. They must become more efficient. They will almost certainly have to cut back, eliminating some programs, reducing enrollments, and in some cases laying off staff. And they will have to ask those more affluent families to pay a bit more of their fair share of the cost of education through higher tuitions, if they are to acquire the resources necessary for financial aid programs, which is the real key to access.

However, let me also note that while state government will not have much capacity to help us in the year ahead, it will have the capacity to do very great damage to higher education in Michigan if it should chose to constrain the options available to our institutions and to deprive us of the flexibility necessary to get through these difficult times. It must resist the tendency to intrude on the management of our institutions during these difficult times, and it must allow Michigan's universities to respond and adapt to hardship as best they can.

Finally, let me urge state government to join with us in higher education, and join as well with our colleagues in the private sector, to develop a long-term strategy for our state. One which addresses the critical structural issues we have put before you this afternoon. We are pledged to work with you, to help in understanding options, and to provide our strong support for the difficult actions which must be taken if Michigan is to regain strength and prosperity once again.

Finally, let me also urge, in the strongest possible terms, that state government join us in accepting our roles of responsible stewards to protect and preserve

these remarkable institutions for future generations. We will all be judged by future historians on how wisely and effectively we protect and sustain this great resource, so critical to our future.

I would like to conclude on a more optimistic note. The good news is that Michigan has built a powerful system of higher education, and this will be a critical strength in the years ahead. As we near the twenty-first century, educated people and the ideas they produce have truly become the wealth of nations. Universities are the prime producers of that wealth. It is higher education that has become the key resource, the competitive edge, for our state and country. By any measure, Michigan has what it needs to turn things around.

We may have to endure more restructuring. The future may call for more sacrifice. But we will change; we will succeed--of that I am sure. As my colleague Paul McCracken said at a meeting recently, "Democracies always do the right thing--after they've tried everything else."

Well, I think that is where we find ourselves today. We have tried everything else.

The time has come to do the right thing.

It's up to all of us.