Proposal to Establish The Michigan Life Sciences Research Corridor

Introduction

Through prudent investment and far-sighted leadership, the State of Michigan has built the University of Michigan, Michigan State University and Wayne State University into three, diverse centers of accomplishment in the life sciences. These institutions now propose to establish The Michigan Life Sciences Research Corridor as a joint venture with the State of Michigan to invest $50 million annually over the next twenty years to further strengthen the quality of research in the life sciences at each of these campuses and to capitalize on their complementary strengths through the support of collaborative projects between them and others, including The Van Andel Institute and industry. The goal of this investment is to move the State into a position of national and world leadership in the life sciences; to improve the health of the people of Michigan; and, to create economic growth and jobs through the development of life science-related industries.

This proposal provides a unique opportunity for the State of Michigan to reap the benefits of a remarkable convergence of several recent developments: the successful, long-term investment it has made in the life sciences at these three leading universities; the creation within the state of a new, privately-funded cancer-research institute with world-class aspirations, the Van Andel Institute; the strong presence within the state of leading pharmaceutical, chemical and agribusiness companies and industries; the success of the Governor's Innovation Forum; the availability of significant new monies from the settlement with the tobacco industry; and, most important, the opportunities revealed by recent discoveries in the life sciences, together with the huge potential benefits they can provide the people of the state. Never before have circumstances been so favorable for the State, by making a single, bold commitment, to ensure not only the future health and well-being of its citizens, but also the effective education and skilled training of its work force and the long-term strength and prosperity of its economy.

Future Of The Life Sciences

During the past four centuries, the natural sciences have undergone remarkable, continuous, super-linear growth and differentiation. Progress in the physical sciences (mathematics, physics, chemistry, astronomy, engineering, geosciences) has generally preceded advances in the life sciences. The physical sciences have been on the leading edge of natural science during the 20TH century but advances in the life sciences have also been spectacular and presage a flowering of these disciplines during the coming years. Looking to the future, it seems likely that the life sciences will dominate natural science and especially its bearing on the larger society during the 21ST century and beyond into the next millennium.

At the close of this century, we are beginning to recognize more clearly the unity of nature, the unity of life and its incredible complexity and diversity of life. So far as we now know, the atoms and molecules that comprise living systems behave according to the same principles that guide the behavior of inanimate systems. The distinctive features of living systems reside in the dynamic arrangements in space and time of these components. By the unity of biology, we mean the remarkable fact that all known organisms use the same genetic code, and that there are many genes found in prokaryotic micro-organisms such as bacteria, in primitive eukaryotic organisms such as yeast, and in small animals such as worms and flies, which reveal striking homologies with human genes. Discovery of functions performed by proteins in yeast and flies often is the most

informative route to understanding the functions subserved by homologous human genes. By the diversity of life, we mean the astonishing variety of life forms present in the plant, animal, and microbial domains on the planet earth. Deciphering the complex connections between genotype and this plethora of phenotypes represent an agenda for research which will occupy scientists for centuries to come. Despite the incredible advances in molecular and cell biology during the 20TH century, the main lesson that we have learned is the awesome complexity of the living systems of which we are part, and both the promise and the enormity of the task that lies ahead.

From this vantage point, some of the directions of future research in the life sciences are clearly discernible. Much remains to be done to identify and characterize the molecules, particularly the macromolecules that comprise living systems. The technologies available for rapid isolation and analysis of such molecules become steadily more effective and powerful. The rapid progress in mapping and sequencing genomes, including the human genome, is a case in point. But the number of molecules to be characterized is immense (about one billion). The project of isolation and chemical characterization which has begun so successfully during the past century will continue at an accelerating pace in the foreseeable future. But increasingly life scientists will turn to the immensely more formidable task of exploring how these molecules interact with one another to form the self-reproducing, self-assembling, living systems that are capable of sensing and responding to environmental signals.

The impact of these probable developments in the life sciences on the larger society, including health care and agriculture will be great. Present progress in molecular genetics and cell biology and related technologies portends new methods of diagnosis and treatment-preventive and therapeutic strategies of a power and subtlety that could not be imagined even a few years ago. We stand on the threshold of effective gene therapy that can be tailored to the unique vulnerabilities of each individual patient. Genetic engineering has already had profound effects on both plant and animal dimensions of agriculture.

Creation of the Michigan Life Sciences Corridor as outlined in this proposal would promote a transition from good, in some cases very good, current programs of research at the three participating universities, to excellence and world leadership in the life sciences. Such research would enable programs of undergraduate and graduate education in the life sciences to attract and retain the very best students. Upon graduation, these students would form a superb work force for an emerging biotechnology industry and for public and private health care institutions that would contribute to the health of the citizens of the state. These attributes–leadership in R&D and top quality graduates-are the signals that venture capitalists and executives of high technology firms look for in making investments and in locating their facilities and operations.

The Michigan Life Sciences Research Corridor

I. VISION AND CONCEPT

The State of Michigan has many assets that can enable it to become a national and world leader in the exploration of this vision for the future of the life sciences and society. In thinking about how best to pursue this future, it is important to recognize that science, like business, is opportunistic. It thrives on the possibility of new opportunities. It exploits new areas and flourishes on competition. It welcomes new technologies and creates new possibilities where none existed before. But the range and scope of the life sciences, in particular the biomedical sciences, are so extensive and the costs so great that no single institution can hope to cover all the areas of promise or exploit all the avenues of application. The Michigan Life Sciences Corridor is envisioned as a powerful vehicle for strengthening the quality of science in the State's three leading universities and stimulating and leveraging new collaborative research

projects across these universities and in partnership with The Van Andel Institute and industry. The creation of such a mechanism for investing in research will position the life sciences research enterprise in Michigan to capitalize on the initiatives already underway in the State to attract new venture capital and high technology industry.

Central to the vision and success of the Michigan Life Sciences Corridor is the desire to raise the quality of research and training at the participating institutions in the relevant fields through the recruitment of new scientific leaders. Experience from other centers of life sciences research teaches that "best in the world" faculty catalyze scientific communities that make the most important discoveries, that attract the best students and nurture the best training programs. These ingredients are highly attractive to industry, and are most likely to influence health and medicine. Over the long term, "best in the world" faculty will continue to attract the best of the younger scientists, thus assuring a process of change, renewal, and continuous upgrading of quality at the participating universities.

Of equal importance in the vision for the Corridor is the desire to stimulate, from the top down and the bottom up, emerging opportunities for collaborative research across the participating universities, and with scientists at the Van Andel Institute and in industry. It is increasingly clear that interdisciplinary research that creates opportunities for pursuing questions in new ways and exploring new applications of existing methodologies has tremendous promise for discovery. In this way, the Life Sciences Corridor is expected to forge new linkages between Michigan institutions that combine the best of each to yield a whole substantially greater than the sum of its parts.

An important goal of the Michigan Life Sciences Corridor is to create a life sciences, biomedical corridor which will rival Silicon Valley as the site of the nation's most explosive scientific, technical and economic growth. The concept is to attract knowledge-based, high technology companies and to build an interactive community of government, industry, and academia. The primary motivation is economic development and job creation. As one entrepreneur put it: Industry is an engine, the university is the fuel providing both knowledge and talent, and the government is the lubricant that keeps the whole machinery all working. Today, eight or nine of the largest revenue producing products in biotechnology involve a collaboration between a university laboratory, a biotech startup, and in many cases a large pharmaceutical company. Reflective of the power and potential for university research to fuel new technologies and industry, the University of California alone has seeded some 70% of the biotechnology companies extant. In a recent speech, the CEO of a leading biotech startup (now pharmaceutical) company pointed out that one-third of the biotech companies in the world are located within 35 miles of a University of California campus. Through strategically driven investment in quality and collaboration, the university participants in the Michigan Life Sciences Corridor have the potential to create a comparable but even more remarkable reality in Michigan.

II. PROGRAM AND BUDGET

The program for the Life Sciences Research Corridor includes two significant thrusts. The first is directed at strengthening existing scientific talent at each of the three participating universities through the recruitment of world-class biomedical scientists in complementary, key fields of research. It is projected that approximately 50 new recruitments at the senior and junior faculty ranks will be needed across the Corridor univerities to achieve the desired improvement in quality. These appointments will recruit the best life scientists in the world, and will be targeted at those areas with greatest potential for contributing to collaborative, interdisciplinary research throughout the Corridor. State of the art facilities and instruments are essential tools of top flight researchers and will have to be made available. A total of $25 million annually will be allocated among the three participating universities for these purposes.

The goal of this component of the program will be to propel the participating universities into the top 5 to 10 leading institutions in their respective areas of the life sciences. While challenging, the recruitment of such a large number of new scientists will be aided by the vision and promise of the Corridor program itself, the existing strength in the three universities and the enormous scientific potential of the new, privately funded Van Andel Institute. Attracting scientists with the requisite talent will require funds to offer competitive salaries, startup support for building labs and acquiring state of the art equipment, funds for moving or building the support staff, and several years of research support until the federal and industrial grants begin to flow in. Based on the recruitment practices of the best institutions as a benchmark, it is estimated that $3 to $4 million will be required for each recruit, in addition to the availability of a State supported faculty slot. A number of these positions can derive from normal attrition.

The second programmatic element of the proposed Life Sciences Corridor is the support of collaborative research projects between scientists at each and among the three participating universities and the Van Andel Institute. A total of $25 million annually will be allocated to such projects. Grants will be allocated by the scientific director of the Corridor on the basis of scientific merit as evaluated by a committee of peers competent to evaluate the applications. To be eligible, proposals must be submitted by two or more universities. Areas of the life sciences to be emphasized in the Corridor grants program will be selected upon interaction with the scientific advisory committee. Selection criteria will include scientific importance, promise and timeliness, the extent of inter-institutional and inter-disciplinary symbioses, and likely benefits to the health and prosperity of the citizens of Michigan. A small allotment of funds will be earmarked each year to provide seed monies to groups of investigators with new ideas that require further exploration or testing. This particular use of the funds is intended to provide capability to respond quickly to test or nurture an emerging discovery.

III. FINANCING

The proposed budget of $50 million a year for 20 years represents a major investment by the State in the life sciences. Clearly, a total of $1 billion, even when spent over 20 years, is a potential "game changer." It cannot be overemphasized that both stability in long term funding and the ability to fund quickly a proposal to explore a new and often risky idea enhance creativity and foster scientific discovery. The Corridor will be able to finance its programs more promptly and flexibly than other competing institutions that are wholly dependent on federal or state annual appropriations. However, the manner in which the institutions set priorities and allocate resources will be an important factor in achieving successful outcomes. Using the investment levels suggested above to build quality at each of the participating universities, an investment of some $250 million in aggregate over the next decade, will be necessary to fuel the Life Sciences Corridor. In recognition of the equal importance of the two unique features of this initiative—building quality and stimulating collaboration, the division of $25 million annually for quality building and $25 million for new joint research projects support makes good sense. This allocation pattern will be reviewed by the governing board and scientific advisory board after the first five years to determine the relative emphasis between the intra-and inter-university aspects of the Corridor program.

The funding of the Life Sciences Corridor will supplement the already substantial funding of Michigan Universities. Building national leadership on top of good quality and stimulating joint and very advanced R&D across institutions with strengths in related but different disciplines will require additional investments to exploit the strengths of these institutions and seize the scientific and economic opportunities now offered by recent developments in the life sciences.

IV. GOVERNANCE AND MANAGEMENT

The Michigan Life Sciences Corridor will be established as an independent, not-for-profit entity. The three universities, the Van Andel Institute, and the State would be institutional representatives on the governing board of the corporation. The Corridor entity will be governed by a structure with three levels of responsibility and oversight. The governance structure will include:

- governing board, consisting of the presidents of the three universities and the Van Andel Institute or their representatives, and a representative from the State, industry, and the scientific community.
- scientific advisory board, consisting of half-a-dozen or so scientists of world stature in appropriate fields. Attempts should be made to have one member be from a Michigan life sciences related industry. (Texas and New York see advantages in using mostly out of state advisors. The Washington Advisory Group Principals have helped these states set up this process.)
- program director's cabinet, consisting of a senior scientific director of the project and the directors of the various joint programmatic ventures in the project.
- Industry/commercialization advisory board, consisting of half-a-dozen or so individuals with expertise in commercialization of intellectual property. Members should include representatives from the venture capital community, industry, and be chaired by the Michigan Economic Development Corporation.

The function of the governing board, as separate from the other boards, will be to provide overall oversight and strategic direction for the project, including, but not limited to, developing criteria for program support and priorities, establishing performance benchmarks and funding levels, providing infrastructure and common facilities, and overseeing quality, educational impact, technology transfer and liaison with the State government. The governing board, in consultation with the scientific advisory board, will be responsible for recruiting a world class scientist to provide leadership to and presence for the Life Sciences Corridor. The recruitment of the right person to this position is essential for the success of the project. He or she should be a recognized leader in the life sciences, capable of articulating the vision of the Corridor and overseeing the management of its programs. Examples of individuals of the appropriate stature are Francis Collins, currently Director of the Human Genome Project, and Nobelist Harold Varmus, Director of the National Institutes of Health.

The scientific advisory board will identify major areas of promise and emergent interest, suggest benchmarks and criteria, assess progress and provide strategic advice to both the governing board and the director. This board will also be responsible for conducting annual reviews of the uses of funds at each of the participating universities, as well as plans for the future; e.g. scientific direction and success of recruitment efforts, future recruitment plans; scope and quality of collaborative research.

The industry/commercialization advisory board would provide a link between the research conducted within the "Corridor" and the potential for Michigan to capitalize on that research. The board would identify technologies, discoveries, and other types of intellectual property that are candidates for the creation and growth of technology oriented enterprises with special consideration to Michigan based start-up companies. The board would evaluate how effectively the universities have taken advantage of commercialization opportunities and advise the Governing Board with their conclusions and recommendations.

The director's cabinet will oversee the overall direction and development of joint research efforts. It will be advisory to the director, who will be responsible to the governing board.

The goal of this governance and management structure will be the support of world-class life sciences research, education, technology development, and their application to health care and agriculture. Governance should respect the distinctive roles and autonomy of the various partners, should encourage creativity and entrepreneurial innovation, should facilitate effective partnership at all levels and provide appropriate review, strategic oversight and accountability. Given these requirements, we suggest that governance should be representative of the major players and that management should be lean, but effective, providing responsible use of resources, but avoiding duplication of effort and unproductive bureaucracy. Both governance and management must be based on access to the most sophisticated scientific knowledge and technical expertise.

A partnership of this scale and complexity needs room to grow and experiment, and this need will be as real for its governance and management as for its science. It is likely that the proposed governance structure will require some modification in light of experience and should be reviewed by the participating universities with the State at five-year intervals. However, any model should provide, at a minimum, strategic direction, coordination and development, effective oversight, quality benchmarks and assessment, optimum translation from research to practice, improved educational quality and appropriate accountability.

Benefits to the State of Michigan

Michigan's public universities can already cite many examples of successful transfer of research from their laboratories to the private sector that demonstrate their ability to contribute to the public wellbeing and the economic strength of the State and the nation. The Life Science Corridor proposal builds on this good record with the potential for magnifying it considerably by building on strength and linking its public universities to form a geographically identifiable entity —in effect, a "research park". It also represents an investment by the state in what is generally considered to be one of the most important, knowledge-based technologies of the next century, that will contribute to both public health and economic growth. Three existing examples of these benefits are:

- Michigan State University. Anti-cancer agents Cisplatin and Carboplatin invented at MSU and commercialized by Bristol-Myers Squib. Royalties paid to MSU exceed $160 million. Clinical applications continue to expand. Agricultural and animal life sciences rated among the best in the country.

- University of Michigan. A national leader in the discovery of disease genes responsible for cystic fibrosis, neurofibromatosis, Huntington disease and more. An established leader in the field of gene therapy pioneering some of the most important developments in this emerging field.

- Wayne State University. Quality life science research in an urban setting is a unique niche that opens many possibilities in basic and clinical research and the development and testing of new diagnostic methods and treatments.

In addition to Michigan's own experience, lessons from other states reveal the potential for measurable benefits, particularly in job creation within the state, as the result of support for life sciences research through a Corridor-like concept. These lessons include:

- Boston and environs (MIT and Harvard). In a 1989 report The Bank of Boston attributed to MIT faculty and graduates the creation of 600 high technology firms in Massachusetts, with sales of $40 billion and the creation of 300,000 jobs. After a major recession, high tech more than any other sector is driving the resurgence of the economy of Massachusetts. Since that time a rapidly growing computer technology, software, and biotech industry has replaced a declining defense

sector. Although computer technology and software are still dominant, there are now some 120 biotech companies in the Greater Boston area, with revenues of $1.6 billion and 15,000 employees.

- Research Triangle Park (Duke University, University of North Carolina, and NC State). Some 92,000 employees and 160 high tech companies were clustered in and around RTP in 1997. From 1992-1997 venture capitalists have invested some $300 million in these mostly software and biotech startup firms. After 3 decades of nurturing by the state, the region influenced economically by RTP's high tech industry has grown from 3 to 13 surrounding counties. Now in middle age, RTP is searching for new approaches to renewal such as increasing venture capital funds for startup or small biotech firms. Nevertheless, in the greater RTP region some 19,000 jobs now exist in the biotech/pharmaceutical fields, and there are some 100 companies with about half startup or small in size. Of the 10 world's largest pharmaceutical companies 6 have facilities in the region. Unemployment in RTP area is less than 2.5%.

- Los Angeles-San Diego corridor (UC Los Angeles,usc, and UC San Diego) The area is second only to the San Francisco Bay area in biotechnology. In 1995 biotech firms in San Diego alone could claim $3.5 billion in revenues with 20,500 employees.

- New Missouri Danforth Plant Sciences Research Center. This institute is a joint project of The University of Missouri-Columbia, Washington University of St. Louis, and the Monsanto Company. It is expected to become the largest plant research operation in the world and its purpose is to use biotechnology to develop more nutrient-packed foods, and a more productive and less polluting agriculture. Monsanto Company has donated more than $80 million and 40 acres of prime land. The private Danforth Foundation has pledged $60 million over ten years. The state is offering various incentives, including tax benefits. The best scientists in agrobiotechnology will be recruited to join the center, with the inducements such as access to modern facilities and equipment, joint university appointments, access to graduate students, and attractive salary packages. With the build up of a top flight staff, competitively based federal grants will become a major source of funds. The promoters have a goal of encouraging the development of new biotech companies specializing in the plant sciences.

These examples reflect in full measure what economists (e.g., the White House Council of Economic Advisors) have increasingly come to recognize, that investment in research and development, more than in capital or labor, is now propelling the nation's economy, accounting for 50% of its growth in the last 40 years.

In addition to benefits from discovery of new scientific knowledge and its application and the economic development which that promotes, the proposed program will yield substantial educational gains at a number of levels. Important as education is as an end in itself, it is also vital to the future health and prosperity of the State and its people. The combination of research discoveries and highly qualified graduates in an identifiable geographic area are strong incentives for local investment and job growth. The following examples illustrate the rich educational possibilities the program provides:

- expanded opportunities in graduate study at the M.S. and PH.D. levels in basic science, clinical studies, social and economic studies and the areas spanning these and other related fields;
- post-doctoral study in these and other areas;
- targeted M.D.-PH.D. Programs, designed to capture and exploit the strengths of the various areas of concentration;
- educational internships for undergraduate and graduate students in industrial, clinical, governmental and "field" settings;
- new courses, programs, majors and concentrations for undergraduates, including liberal arts courses, devoted to major themes (e.g. the biology of aging, the genetic basis of health, gene therapy and its ethical implications);

- advising, teaching and counseling opportunities for visiting and other scientists, serving as adjunct faculty members;
- workshops for teachers in selected topics;
- public education in public health;
- statewide educational themes;
- conferences and symposia (e.g. speeding technology transfer, new findings in the treatment of diabetes, venture capital in pharmaceutical development);
- professional refresher courses and conferences (e.g. for continuing medical education).

The governing board and project director will need to consider how to supplement existing campus-based educational programs with new cooperative efforts. While the program must respect the responsibility of each campus for its own programs, the task of harnessing the combined talents (including those of industry, health care professionals and government) will require new methods of oversight.

Conclusion and Additional Considerations

The present proposal—bold in its concept, embracing in its membership and involvement, modest in its costs, but unparalleled in its breadth and unmatched in its potential impact—is an investment in the future of the State that promises to be a "game changer" of historic significance. The strength and breadth of the vision for this initiative are best described as follows:

- the motive that underlies the proposal is discovery.
- the method that underlies the proposal is a new level of partnership between institutions, government, industry and the private sector.
- the standard that underlies the proposal is excellence, based on world-class research by bioscientists, young and old, of international stature.
- the products of the present proposal will be new knowledge, new educational opportunities, sophisticated advanced training, an increasingly skilled work force, major advances in health care and disease prevention, extensive industrial application and development, improved pharmaceutical products, biomaterials, natural products and livestock and longer-term technology transfer to fields now scarcely identified or defined.

Michigan is nearing the end of a year-long process, The Governor's Innovation Forum, with the goal of fostering collaboration between its universities, industries, and state agencies to attract new knowledge-based business into the State has pointed the way to a next century in which advanced training and R&D will be major catalysts for job creation and economic development. The proposal by Michigan State University, the University of Michigan, and Wayne State University with the participation of the Van Andel Institute to create a Life Sciences Research Corridor is an excellent example of an initiative with an outcome that the forum aspires to achieve. The Corridor builds indigenous strength to new heights, and demonstrates an entrepreneurial mindset in welcoming linkages to industry and contributing to state government goals of economic development based on industries of the future. The Governor's Innovation Forum is considering several mechanisms for attracting industry, venture capitalists, and encouraging new startups. The Washington Advisory Group views these approaches as complementary to the Corridor initiative rather than in competition with it. The combination is a powerful driver for economic growth. In an important sense the Corridor plants the seeds for a much more abundant harvest by the commercial sector than would otherwise be available.

The proposed Michigan Life Sciences Corridor represents an important programmatic initiative that will prepare the State to take full advantage of the infrastructure envisioned by and planned for by the Governor's Innovation Forum. There will, no doubt, be many claimants for the State's support, and many worthy causes and pressing needs represented by their claims. But the

Corridor proposal needs to be viewed in a category by itself because its impact promises to be so profound and its benefits so far-reaching. Almost all claims for State support deal with existing needs in all their urgency, within the State as it now is. The Life Sciences Corridor concerns the State as it might be: a world class center of discovery in the critical area of the life sciences, providing not only new knowledge of immense value and transforming significance, but also new applications, new technology, new medical procedures and devices, new investment, new industry, a world class cadre of scientists, technicians and clinicians, and a skilled, adaptable, high tech workforce, together with all the untold benefits to the health, well being and prosperity of the people of the State and the nation that these will provide. This proposal is an opportunity to shape the development of the State, to transform its economic outlook and to create a future full of promise.

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