

THE KILLAM TRUSTS

**2001
KILLAM
ANNUAL
LECTURE**

**Higher Education in the Higher Education
Economy: Towards A Public Research Contract**

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Izaak Walton Killam

Born in 1885 at Yarmouth,
Nova Scotia

Died in 1955 at his Quebec
fishing lodge



*Dorothy Brooks Killam, née
Johnston*

Born in St. Louis, Missouri in
1899

Died in 1965 at La Leopolda,
her villa in France

THE 2001 KILLAM ANNUAL LECTURE

The Montreal Neurological Institute at McGill University was the venue for this year's sparkling — and challenging — Killam Annual Lecture. Dr. John R. Evans, Chair of the Canada Foundation for Innovation, held the attention of a rapt audience of over 250 for little short of an hour, followed by a half hour of questions that continued throughout the Reception following.

We are fortunate indeed to have the considered views of a man so multi-talented as John Evans on the theme of the Killam Annual Lecture series, namely the importance of research at Canadian universities. There can rarely, if ever, have been a Canadian scholar whose vast achievements and broad experiences are so well fitted to our purpose. Dr. Evans' *curriculum vitae* appears at page 7 of this booklet; what strikes one so forcefully is that this pre-eminent scholar is equally at home in academic administration, in government service both national and international, in charitable foundations and in business.

Not only is Dr. Evans' presentation a model of clear and purposeful prose, but it fulfills admirably the Killam Trustees' purpose of stimulating debate about research along new and innovative paths. For Dr. Evans' thesis is that there now exists in inchoate form a "Public Research Contract" between governments as the principal funders of academic research, and universities as the recipients of that funding. To shore up the long-term obligations that each has to the other, this Contract should now be formally sealed.

In arriving at the Public Research Contract, there are, of course, many important issues to be resolved. Dr. Evans identifies these, and tackles many of them in detail in the course of the Lecture, often proposing highly innovative solutions. As an example, he suggests we consider a rule, parallel to that which exists in the United States, requiring that intellectual property developed at Canadian universities through the use of public research funding may only be commercialized by Canadian based companies.

One final point: Dr. Evans' hopes for the success of Canadian universities extend far beyond Canada. He is passionate about the obligations Canadians owe to both the under developed and the developing worlds to spread the benefits of our knowledge based society. In short, Dr. Evans is an internationalist of the finest Canadian kind, as his extraordinary international career demonstrates. Citing Michael Ondaatje's penetrating observation that "The drama of our age is the coming of man into one fate," Dr. Evans longs for the day when, through the exertions of our universities and our governments working together, Canada can reclaim its once starring role in international development. May his vision be amply and early fulfilled.



For copies of this or any of the six previous Killam Annual Lectures, you can write to Christine Dickinson, Administrative Officer of the Killam Trusts, at the address on the outside back cover. The Lectures are also found on our Killam website: <http://www.dal.ca/killamtrusts>

For a list of the previous Lecturers and Lecture titles, see the inside back cover.



THE KILLAM TRUSTS

The Killam Trusts were established through the generosity of one of Canada's leading business figures, Izaak Walton Killam, who died in 1955, and his wife, Dorothy Johnston Killam, who died in 1965. The gifts were made by Mrs. Killam both during her lifetime and by Will, according to a general plan conceived by the Killams during their joint lifetimes. They are held by five Canadian universities and the Canada Council for the Arts. The universities are The University of British Columbia, University of Alberta, The Univer-

sity of Calgary, Montreal Neurological Institute of McGill University, and Dalhousie University.

The Killam Trusts support Killam Chairs, professors' salaries, and general university purposes; but the most important part of the Killam Program is support for graduate and post-graduate work at Canadian universities through the Killam Scholarships. In each of the Killam universities and at the Canada Council, they are the most prestigious awards of their kind.

The Canada Council also awards annually five Killam Prizes, in Health Sciences, Natural Sciences and Engineering, and beginning in 2002, Social Sciences and Humanities. Worth \$100,000 each, these are Canada's premier awards in these fields.

To date, close to 4,500 Killam Scholarships have been awarded and 58 Killam Prize winners chosen. The current market value of the Killam endowments is some \$400 million.

In the words of Mrs. Killam's Will:

“My purpose in establishing the Killam Trusts is to help in the building of Canada's future by encouraging advanced study. Thereby I hope, in some measure, to increase the scientific and scholastic attainments of Canadians, to develop and expand the work of Canadian universities, and to promote sympathetic understanding between Canadians and the peoples of other countries.”

John H. Matthews

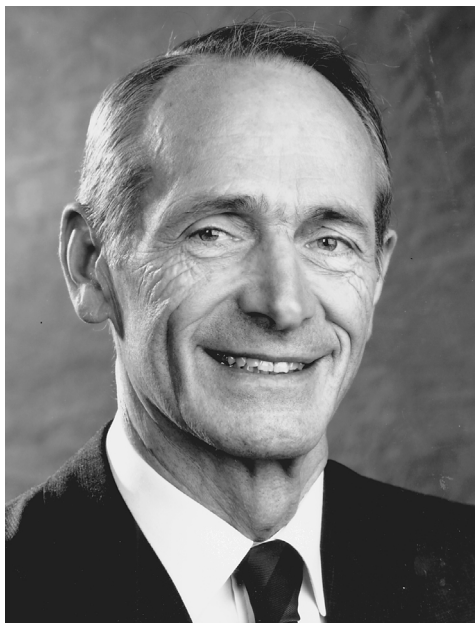
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John Robert Evans

JOHN ROBERT EVANS

Dr. Evans is a Canadian physician who received his undergraduate medical training at the University of Toronto and engaged in specialty training in internal medicine and cardiology in London, England, Boston and Toronto. Following five years as a member of the Department of Medicine at the University of Toronto and consulting physician at the Toronto General Hospital, he was appointed as the Founding Dean of the McMaster University Faculty of Medicine in Hamilton, Ontario. From 1972 to 1978 he served as President of the University of Toronto. In 1979, he undertook a study of education for public health and population-based medicine supported by a grant from the Rockefeller Foundation to the University of Toronto. From 1979 to 1983 Dr. Evans served as Director of the Population, Health and Nutrition Department of the World Bank in Washington. In 1983, he returned to Toronto as Chairman and C.E.O. of Allelix Inc., a biotechnical research company. He is currently Vice-Chair of the merged company, NPS/Allelix Biopharmaceuticals Inc. Dr. Evans also serves as Chairman of the Board, Alcan Aluminium Limited in Montreal, The Canada Foundation for Innovation in Ottawa and Torstar Corporation in Toronto. He is also a member of the Board of Directors of several Canadian corporations.

Dr. Evans is past Chairman of the Walter and Duncan Gordon Charitable Foundation, past Chair of the Board of Trustees of the Rockefeller Foundation, Past Chair of the Global Stewardship Initiative of the Pew Charitable Trusts, past Chairman of the Institute for Clinical Evaluative Sciences and past Chairman of the Provincial Co-ordinating Committee on Community/Academic Health Centre Relations advisory to the Ontario Minister of Health.

THE 2001 KILLAM LECTURE

HIGHER EDUCATION IN THE HIGHER EDUCATION ECONOMY: TOWARDS A PUBLIC RESEARCH CONTRACT

John R. Evans

Canada, like other industrialized countries, has embraced the new knowledge-driven economy as the source of the future wealth creation necessary to sustain and improve our standard of living and quality of life. This knowledge-driven economy is based on the discovery and development of new ideas and their successful commercialization in the form of new products, services, and processes. The currency is human capital, or ideas, rather than physical capital represented by manufacturing infrastructure or natural resources.

This knowledge-driven economy is powerfully facilitated by the information and communications technologies which have broken through conventional institutional and bureaucratic barriers to allow the rapid and effortless exchange of information within enterprises, among institutions and across national borders. It operates in the global arena. The limits and controls of political geography have been eroded. Nationalist and protectionist rules governing economic behavior are giving way to greater freedom of movement across national borders, not only of goods and services and financial capital, but also and more importantly, of ideas and people. We now live in a world in which the organized ability to create and commercialize new ideas is the critical determinant of economic success.

Universities are strategically positioned to be pivotal in this new knowledge-driven economy because of their traditional roles in higher education and in advancing the frontiers of knowledge and understanding. And Canada's success in the years ahead will depend more than ever before on future generations of university graduates and the new knowledge and ideas they produce.

But universities cannot take their monopoly for granted. New niche competitors, public and private, local and international, have emerged in purely educational services like the Open University, Phoenix University or Jones International. Research institutes outside university jurisdiction where scholars are unencumbered by teaching and administrative responsibilities are increasing. Universities must earn their place by performing at international standards of excellence in both education and research. Best in Canada is no longer even a consolation prize.

The knowledge-driven economy depends on people with creative, synthetic and critical talents to drive the generation and application of new ideas for useful purposes. The overriding challenge for higher education institutions is to continue to attract the best minds and to provide the resources and environment which will allow them to express their full potential. This is not new. What is new is the scale which is now expected, the magnitude of resources required, the increased number of players on the field, and the intensity of competition for gifted human capital, both faculty and students. What is also new is the expectation that universities will augment their effectiveness in technology transfer in a way that truly contributes to wealth creation in Canada.

The thesis of this Killam Lecture is that universities are undergoing a transformation triggered by what I shall call the Public Research Contract. The Contract is between governments and the universities. It involves longer-term commitments by both parties. For government it is a much higher level of investment than previ-

ously provided to Canadian universities for their traditional role in the creation and transmission of knowledge. For universities the commitment is economic and social return on public investment, and particularly, jobs and wealth created in Canada. It entails new levels of accountability to perform at international standards of excellence, to use efficiently substantial public funds, and to promote commercialization of the resulting intellectual property.

Why is the Public Research Contract transformational? It is because of the anticipated scale and duration of public investment in university education and research and the explicit expectations of national economic return. The Public Research Contract will place new demands on universities and granting agencies to evolve their processes of research support. It will intensify the interaction of the academy and business. It should encompass a global vision not just to interact with research leaders in the industrialized countries but also to establish research partnerships to assist less prosperous societies resolve problems impeding their development.

THE PUBLIC RESEARCH CONTRACT

Financial resources will be a critical determinant of the universities' ability to attract and nurture talented people. After many lean years of federal support of research in Canada there has been a significant turnaround. Over the past four years a series of federal programs have been launched: The Canada Foundation for Innovation for the support of research infrastructure in universities and teaching hospitals; increased funds for the established granting councils and expansion of the Medical Research Council into the Canadian Institutes for Health Research; creation of the Canada Research Chairs; the Canadian Health Services Research Foundation, Genome Canada and the Sustainable Technology Development Fund. At the same time provinces have joined in support of research and innovation in major programs, some of which antedate the recent federal initiatives, e.g., in Quebec and Alberta. For its part, Ontario

has also become much more active in the support of scientific research. In brief, Canada appears to have entered a new constructive era of complementary federalism in support of research.

Looking forward the prospects are bright. The Government has committed to move Canada from 15th in the level of research support to one of the top five industrialized countries by 2010. The boldness of this commitment is underlined by the recognition that the comparator countries will not be standing still. Our closest competitor for research talent, the U.S., already has underway a doubling of research investment in the National Institutes of Health between FY 1999 and 2003. Our government's commitment goes well beyond the level necessary to sustain the traditional role of research in the university as a companion piece to its educational mission. The increased resources are being allocated to increase Canada's capacity for wealth creation in the knowledge-driven economy, a necessity given the fact that the developing world will increasingly produce many of the standard products and services now produced in the advanced economies while other advanced economies will be seeking to gain competitive advantage from the commercial application of new knowledge or ideas.

The goal is more than the support of good research. It is a Public Research Contract with universities based on the expectation by government that well-trained people, new ideas and intellectual property resulting from the substantial incremental research investment will be important factors in creating jobs and new wealth in Canada. As the federal government's Speech from the Throne said in January of this year, "to secure our continued success in the 21st century Canadians must be among the first to generate new knowledge and put it to use." So this is an unprecedented challenge for our universities, one that will require radically new ways of thinking, acting, and organizing. If universities fail to adapt to this new

challenge, as embodied in the Public Research Contract, government support will undoubtedly stall or be directed elsewhere.

The success of the Public Research Contract will be strongly influenced not only by the amount of money invested but also by the investment strategies of the public granting agencies. The Canada Foundation for Innovation (CFI), the first and largest of the recent federal research initiatives, departs significantly from the model of the established granting agencies in several important respects:

- It was set up as a foundation, arm's length from government in its operations with the majority of its board independently appointed.
- In a series of transfers, it has been provided up-front with over three billion dollars, to be disbursed over an extended period of eight to ten years, protecting it from annual fluctuations in government funding.
- The requirement for the universities to mobilize matching funds has stimulated the provinces to play a major role not only in organizing funds for the match of the specific infrastructure projects but also in establishing their own policies, priorities and mechanisms to support university research.
- Unlike funds from the established granting agencies which respond to applications from individual investigators, the CFI infrastructure grants require applications from the institution and a statement of the institutional research strategy. This has required a priority setting process by each university increasing the differentiation of the institutions within the system as they focus their resources on selected areas of strength.
- Specific granting strategies have been introduced to recognize the distinctive approaches to research excellence in large and small universities and colleges/CEGEPs in keeping with the

belief that differentiation of roles rather than homogenization best serves the national interest.

- International grants have been added to facilitate research alliances of outstanding Canadian groups with best of class elsewhere, reinforcing the aspiration of Canadian institutions to perform at global standards of excellence.

The several federal and provincial research initiatives since 1997 have upgraded research infrastructure, assisted Canadian institutions to attract excellent new faculty members and have substantially improved the morale of the research community. The achievements reflect very favourably on the leadership of the federal government and its Ministries of Finance and Industry. Particular credit should be given to the AUCC for presenting the case for the universities so persuasively to government. Some of the recently established instruments such as the Canada Foundation for Innovation and Canada Research Chairs have been set up in such a way as to give universities greater certainty on which to base longer-term plans to invest in people and infrastructure. This approach by government fits well the concept of a Public Research Contract.

As the most important source in generating discoveries, the universities must accept in the Contract, the obligation to undertake the fundamental reforms of their operations necessary to become competitive at international standards of excellence and to be included in the networks and partnerships with the global leaders in their fields. These reforms include increasing the speed of adaptation to continuously changing circumstances, exploiting fully the potential of information and communication technologies, eliminating cumbersome bureaucratic processes, encouraging multi-disciplinary initiatives, and creating a transparent, supportive and decisive institutional culture.

In a period of rapid and pervasive change universities must preserve their enduring values but increase greatly their agility to adapt their strategies and processes. Otherwise they will be left behind. This is more than greater efficiencies. The real breakthroughs come from imaginative ways of doing things differently.

If universities are to contribute significantly to Canada's transformation into a knowledge-driven economy, other conditions must be met so that they can enhance their contribution to commercialization. University offices for technology transfer will need to be strengthened, possibly through expanded intern programs. Greater clarity on ownership of intellectual property from university research funded by government is required. There is a strong case to be made that ownership of intellectual property rights arising out of publicly funded research should be vested in universities for production *in Canada* – similar to the U.S. requirement for federally funded research in U.S. universities. A clear “production in Canada” requirement would create a more positive environment for successful licensing and commercialization in Canada. New external institutional arrangements and financial incentives are needed to rectify weaknesses in the commercialization value chain in Canada, e.g.

- A financing mechanism to fill pre-commercial gaps in the development of intellectual property.
- Support for research parks which cluster research-intensive firms and support infrastructure to nurture small companies and university spin-offs.
- Additional tax related mechanisms to attract capital for small technology development companies.

With the right mechanisms in place to create a receptor capacity for research, it will be reasonable for Canadians to evaluate how well universities are meeting the economic goals of the Public Research

Contract. The criteria they could look to might include the output of graduates in the fields of new knowledge, the extent to which Canadian knowledge-driven employers are able to fill their requirements for highly qualified people in Canada, the new companies in Canada whose development is catalyzed or facilitated by university research, and the extent to which licensing contracts for university-based intellectual property lead to commercial enterprise in Canada.

The challenge to Canadian universities is far reaching. Can they adapt their processes and culture to the new reality of the knowledge driven economy and global competitiveness? The primary objective of institutional reform is to provide a compellingly attractive environment for human capital. As the McKinsey study, *“The War for Talent”*, put it – “Tell me again: Why would someone really good want to join your organization?”

The recruitment challenges are staggering especially in larger universities which expect to hire over 100 new faculty each year for the next five years. According to eMPOWER Canada, if Canada is to have the additional postgraduate degree holders needed in photonics, microelectronics and wireless and radio engineering alone, the number of faculty in this field will need to triple from about 350 now to 1,050 in the next few years.

Over the next decade universities and colleges in Canada face a wave of retirements as well as increased enrolments creating a demand for more than 30,000 new faculty. Canadian institutions are unlikely to win out on compensation alone, especially against the deep pockets of the leading U.S. research universities. But they can win with the right quality of colleagues, research resources and organizational culture. How much coaching and support do we provide to attract our faculty and help them grow? Most universities would move significantly further ahead in the war for talent if they gave the same priority to asset management of human resources that they do to asset management of their financial portfo-

lio. As Peter Drucker points out, “think of employees as volunteers. They can go anywhere”. This is an especially important consideration, given the fact that the top U.S. universities will be actively seeking to recruit the best and the brightest from Canada and other countries with world-class faculty and students.

The universities face a similar challenge in expanding masters and doctoral training to meet existing and new needs for highly qualified personnel for all sectors. To attract the best candidates in a highly competitive market, universities must ensure that their programs offer excellent training and research experience. Regrettably many graduate programs fall short in terms of time to degree, successful completion rate, effective supervision, access to critical research resources such as computing power and broader exposure during training to other disciplines and career opportunities. Financial support for graduate students in course needs to be competitive for North America and incentives such as forgivable loans might be added as an inducement to remain in Canada after graduation.

Strengthening universities is only half the challenge! Governments and their granting agencies have an obligation to review their policies and practices to ensure they are optimally supportive in both the short and long-term, e.g.,

- Government should recognize the international mobility of talent and revise immigration policy to facilitate and expedite international recruitment and to encourage graduates to remain in Canada.
- Ensure that mission-oriented conditionality in research grants does not eclipse the opportunity for excellent investigator initiated academic research which is so important to future discovery and paradigm shifts.

- Determine whether adverse consequences for different fields of research or categories of institution result from the requirements for substantial matching funds.
- Make provisions for universities to recover indirect costs of research from the granting agencies. Based on a RAND study for the U.S. Office of Science and Technology Policy, indirect costs related to but not covered by research grants in Canada are estimated at 32 to 45 percent of direct costs. In the U.K. the estimate is 20 to 25 per cent.
- Standardize as much as possible of the basic grant application format and review requirements of the different granting agencies at federal and provincial levels.
- Award substantially larger grants of longer duration to established investigators. Currently investigators prepare multiple applications frequently to a variety of agencies to cobble together the resources necessary for their research. The average federal research grant in the U.S. is threefold larger than in Canada.
- Coordinate national granting strategies to launch major new research platforms such as bioinformatics, genomics, nanotechnology and stem cells. Canada's optical fiber backbone facilitates implementation of geographically dispersed consortia and networks.
- Recognize in granting policies the rapid obsolescence of sophisticated measurement instruments and the indispensability of massive computing power. As the New York Times article earlier this year by George Johnson points out "... as research on so many fronts is becoming increasingly dependent on computation, all science, it seems, is becoming computer science."

With the large number of federal and provincial research agencies and diversity of practices it is important to ensure that the whole is more than the sum of the parts in making Canadian universities attractive and highly productive places to work. A review of current granting agency practices in Canada and other relevant jurisdictions such as the United States and the United Kingdom would be timely. The objective should be to stimulate universities and granting agencies to consider how they can meet more successfully their respective obligations in the Public Research Contract while at the same time ensuring that operating budget support for education of undergraduates and graduates is not shortchanged.

THE NEXT WAVE

University research has been a pioneering force in paradigm shifts and waves of technological innovation, for example, in computing, telecommunications and the Internet. This information revolution is far from over, as advances in new materials facilitate the continuation of Moore's Law for some years to come while continuing discoveries in photonics will bring a similar advance in communications. But as we look to the future, the most promising new scientific frontier will be in the biological and life sciences. Unraveling the genetic information system in humans and lower species has greatly accelerated research on the multistage processes controlling the structure and function of living organisms. How signals are transmitted and received and the nature of intermediate and ultimate processes is now the focus of intensive research in genomics, proteomics and organomics. This dynamic field of research promises major advances in the understanding of learning, memory and behavior and in the design of interventions to diagnose, treat and prevent disease.

While genomics has occupied centre stage, advances have been spectacular in other areas of biological science such as immunology, neurobiology and electrophysiology. In parallel there have

been rapid technological improvements in the speed, precision and sensitivity of measurement devices to enable rapid screening of large numbers of chemical entities, determination of three dimensional structure, detection of parts per billion of the products of biological processes in cells and imaging techniques to visualize not only detailed structure of organs but also their functions, e.g. the activation of specific nerve pathways.

The explosive growth of fundamental biological knowledge would not have occurred without extraordinary technological innovations to measure, simulate and modify biological processes, e.g., sophisticated analytic instrumentation, robotics, computation and bioinformatics to digest the voluminous information. These technological innovations were the result of convergence of disciplines such as physics, chemistry, mathematics, engineering and computer science with the biological sciences, a creative, interactive process which the university is uniquely equipped to facilitate.

A different dimension of life science knowledge has emerged from the interaction of biological sciences with the social, behavioural and epidemiological sciences. From these studies there is evidence that health outcomes, regardless of the specific diseases, are strongly influenced by external determinants such as poverty, social gradients, workplace hierarchy and a sense of security. In early childhood, lack of stimulation and stress without social support can modify biological processes in such a way as to result in chronic or lifelong difficulties in cognitive development, behavior and socialization, health and life expectancy. It is from these kinds of studies that insights will come to address the medically intractable problems of aboriginal health, studies which must be done in genuine partnership with Aboriginal Peoples. This should be the highest priority for the newly established Institute for Aboriginal People's Health of the Canadian Institutes for Health Research.

The Canadian Institute for Advanced Research program in Health and Human Development has been a world leader in this field of research. Its success reinforces two important principles in the conduct of research in universities: first, the powerfully creative potential from carefully orchestrated multidisciplinary interactions of social and biological sciences; and, secondly, the capacity for a virtual research team assembled from institutions around the world to achieve a concentration and diversity of talent rarely possible in a single institution. Both principles have implications for the future organizational behavior of universities. Sovereign silos by discipline or by institution seem antithetical to the borderless terrain of human inquiry characteristic of the knowledge-driven economy.

Biomedical and health sciences research now represents a significant segment of the total Canadian research commitment. In universities with a medical faculty and affiliated hospital research institutes it accounts for about half of all external research grants received. World class research performance will be elusive without differentiation within institutions to build areas of great strength and collaboration among institutions to achieve critical mass and complementarity of strengths.

Canada currently has outstanding biological and life science research potential. But this could easily be squandered without appropriate support, as has been the case in the past. Dr. Lou Siminovitch, the father of molecular genetics in this country, has pointed out that Canadian scientists, with few notable exceptions, lagged behind by more than a decade the wave of innovation in molecular biology which followed the descriptions of the triplet code and double helix structure of DNA. Similarly, when recombinant DNA technology was introduced it took nearly a decade before its significance was recognized and the techniques applied to research in Canada.

Coming late to the party has real costs. Why have we lagged in the past? Dr. Siminovitch believes that without a revolution in our

nation's history and with a scientific and economic colossus next door we have adopted a risk averse culture of following, not leading. It is too easy for the universities and the granting agencies to accept a national quality benchmark. Our research groups must believe we can conquer anything and adopt a scientific frontier mentality to be Number One by global standards.

Now there is a tidal wave of new opportunity in biological and life sciences. It's vitally important not to miss out. It will be the engine of innovation in health, the largest sector of the world economy. But the reach of the new molecular biology technologies extends to all life processes including reproduction itself, the food we eat and the remediation of our environment. Biological literacy must become an important part of undergraduate education not only for future academics, health professions and life science industries but also for careers in management, finance, teaching, law, policy and regulation.

The tidal wave in molecular biological sciences is being followed by a powerful after wave engaging the humanities and social sciences and touching on fundamental questions of ethics, privacy, risk and reward, even the freedom of scientific enquiry itself. Disciplines throughout the university can contribute through research to better-informed public debate on these issues. Faculties of education must lay the groundwork for the next generation by providing a broad and dynamic presentation of modern biological sciences in the school curriculum.

It is essential that universities and public research agencies are motivated to recognize and catch new waves such as that now underway in biological sciences. The Public Research Contract must be forward looking and make provision for them to do so. And, it is equally critical that they do so in a way which engages the diversity of academic disciplines in the university. As the late Professor George Storey, legendary orator at Memorial University convoca-

tions, proclaimed, “We must humanize our scientists and simonize our humanists!”

THE ACADEMIC-COMMERCIAL INTERFACE

The basic premise of the Public Research Contract is that augmented investment in university research will enhance economic development *in Canada*, i.e., create jobs and wealth in this country. It would be an unsatisfactory return on investment if all it produced were trained personnel and intellectual property for export.

To meet public and institutional expectations universities must improve their technology transfer capability and facilitate interaction with receptors, where they exist, to move intellectual property down the value chain of wealth creation and employment in Canada. As the federal government’s Throne Speech stressed in January, its plan was to “continue to pursue excellence in Canadian research by strengthening the research capacity of Canadian universities and government laboratories and institutions.” But, it added, there was also a need to “accelerate Canada’s ability to commercialize research discoveries, turning them into new products and services.”

We should not underestimate the obstacles to improving commercialization. The recent report of the federal government’s Advisory Council on Science and Technology states “that most intellectual property requires a great deal of added value before it is market ready.” Their report, “*Issues With Respect to Commercializing Canadian University Research*”, notes that “conceptually, the steps in the chain of commercialization are carrying out research, followed by initial development, bench scale-up, prototyping (piloting), and scale-up to full production. Two problems associated with this are the lack of ‘pre-seed’ funding for the bench scale and prototyping stages, and the problem of picking the right intellectual property to concentrate on”. All this can be quite costly, and must be done without taking away from budgets for actual research in

fundamental science. Yet as the study stressed, “there is a consensus that there is a critical and difficult step during which value must be added to the intellectual property before commercialization can occur. Pre-commercialization involves adding technical value, bundling technologies, accessing capital, ‘guided entrepreneurship’, mentoring, incubator support, etc.”

Information recently collected by AUCC confirms that commercialization of academic research has made progress in Canada during the past five years. The report, “*Commercialization of University Research*” notes that by 1999 Canadian universities had reduced – but certainly not eliminated – the gap when compared with U.S. universities in invention disclosures, licenses and spin-off companies factored in relation to total sponsored research expenditures. But direct financial returns to Canadian universities have remained low. License income of the top 15 universities was less than one-third their U.S. counterparts. Incubator facilities and research parks have been started but the scale is still small compared to the U.S. Venture capital funding has grown from less than \$200 million in 1995 to almost \$1.2 billion in 2000 but it still lags substantially behind U.S. sources in availability and, with rare exceptions, in risk tolerance. Access to capital is still very limited for proof of concept or prototype financing of university research.

One major problem in Canada is the limited number of companies capable of functioning as receptors for intellectual property. Experience in the U.S. indicates that new start-ups and small firms have been the primary vehicles for commercializing new technologies since World War II. The U.S. experience has been unique among industrialized countries. It appears to result from the tide of new knowledge produced by massive public investment in university research, lowering entry barriers by liberalizing licensing of key technologies through anti-trust suits, preferential treatment of small firms in the huge federal government procurement programs and the emergence of a dynamic venture capital industry.

Recent studies indicate that small firms do better than large firms in generating innovative activity from university research and shortening the interval between academic discovery and industrial application, although large corporations are also playing a greater role in seeking out and commercializing new knowledge from universities and associated research hospitals. In addition, it is the large enterprises which have the financial and distribution capacity to carry new products forward. Here, Canada relies heavily on the international pharmaceutical industry because we lack a Canadian-controlled receptor capacity with this scale and scope. Canada does not yet have the array of companies committed to technological development and financially strong enough to bring a portfolio of prospects to market.

It will take time to grow a generation of profitable, small knowledge-based enterprises in Canada with the scale and scope to be major players. A major step forward, however, could be achieved by establishing research parks adjacent to research intensive universities. Michael Porter of Monitor Corporation and Roger Martin, Dean of the Rotman School at the University of Toronto, have emphasized the importance of geographic co-location of business, financial and academic enterprises which feed on each others' ideas and experience and thereby facilitate each others' development. These clusters become a magnet for a diversity of talent and a visible address in the global science and technology network. When actively managed with the appropriate mix of constituents research park clusters have many advantages.

- They facilitate technology by bridging the gap between the source of intellectual property and receptor companies and by providing access to pre-commercial advice and funding for proof of concept, prototyping and bundling of intellectual property.

- They enhance the opportunity for university scientists to play an active role in the commercialization of their discoveries – an important consideration for some faculty members in their choice of university employment.
- They provide ready access for entrepreneurial firms to knowledgeable support services such as management, financing, legal, patents and head hunters among others and to necessary infrastructure such as animal facilities, computing and complex measurement technologies without the distraction of trying to develop them as part of their own corporate infrastructure.
- They provide a platform for the interaction of the diverse university disciplines and the different science-based entrepreneurs from which new insights may advance commercialization within their companies or lead to the creation of entirely new ventures.
- They enhance survival rate and speed to market of start-up companies.

Geographic location has been a key determinant in the genesis of the new biotechnology industry, as it has been for other industries based on new knowledge. Silicon Valley in California and Silicon Valley North in Ottawa-Carleton are examples in the world of information technologies. The majority of biotech start-ups in the U.S. were founded in three regions: the San Francisco Bay area, southern California and Harvard/MIT; 70 percent of the founders of these firms continued to hold academic appointments through the initial public offering. Proximity to a strong university matters a great deal to established companies in terms of privileged access to commercially valuable knowledge and technology.

Actively managed research parks adjacent to research intensive universities can serve as the instrument to achieve the substantial benefits of clusters. Regrettably, in Canada there is no government

program to encourage their development. Experience elsewhere indicates the need for some public subsidy to get them launched as not-for-profit organizations.

Even without convergence centres or cluster parks the interface between academic and commercial, public and private has become increasingly blurred. University research, faculty positions, student stipends and research infrastructure may be supported by exclusive arrangement with a commercial entity. The classical sequence of university discovery research followed by commercial development has given way to telescoped and interrelated academic and commercial research and development. Technology-intensive companies are often engaged in basic research which is complementary to university research. They make available sophisticated or exclusive technology which the university is unable to access or afford. For some projects the size and diversity of the research team and the expense of batteries of equipment and super computing power make academic participation unaffordable without an alliance with a commercial partner.

Faculty members in increasing numbers want to see their discoveries applied. Many now want to carry two cards, one for their academic professorial post and the other for their role as a scientific officer in the corporation commercializing the results of the research. And they want their twin careers manageable within weath-erproof walking distance! Students and technical staff may also benefit from exposure to start-up and established companies which provide valuable apprenticeship experience and open up new career opportunities.

On the other side of the ledger, the academic-commercial interface is loaded with potential landmines:

- Conflict of interest for the scientist or the institution
- Undue privatization of new knowledge

- Restraint on timely publication of research results
- Conflicting legal claims to intellectual property
- Distortion of the graduate student research experience by undue secrecy or commercial pressure
- Faculty neglect of educational responsibilities
- Excessive dependence on short term soft money
- Undue influence by a dominant financial patron dictating the path of scholarly inquiry
- Internal jealousies or ideological clashes over imbalance of resources and responsibilities among departments and faculties of the institution

The list is by no means complete. But it illustrates the need for active management of the academic-commercial interface to reap the potential rewards for faculty, staff, students, the institution and society without risking the basic purposes of the institution. Recent high profile problems illustrate that universities and affiliated hospitals have some way to go in developing broadly accepted policies and practices to achieve this balance. Setting the highest standards of integrity, objectivity and independence and establishing transparent and credible review processes to prevent and resolve problems are of the utmost importance. They are vital to establish trust - trust by those who work within the institution, trust by external collaborators and trust by the public which depends on universities for informed and objective decisions and on which universities depend for financial support.

A GLOBAL VISION

Much of the justification for the Public Research Contract is based on strengthening Canada's position relative to other leading industrialized countries in the global economy. But the global objective

should also include provision for engagement of our higher educational and research capability to address the pressing problems of the developing world.

Industrialized countries are investing heavily in academic research and technological development to compete in the knowledge-driven economy. The result is a further widening of the gap between the more affluent industrialized countries with their powerful corporations, strong research institutions and abundant venture capital and the countries of the developing world with none of the cards in hand to catch up even in the most basic of human needs – health, literacy, economic opportunity and human security.

There is a great temptation to solve our shortage of academic staff by raiding the limited resources of developing world and former Eastern Bloc institutions. We want their brains. They want our technical resources. But we can meet both goals without brain drain. There are excellent examples of mutually advantageous virtual partnerships with information scientists from India or physicists from Russia, which have demonstrated outstanding scientific performance through access to better equipment without relocation of people.

The global vision of the new knowledge-driven economy must not be allowed to exclude more than half of the world's population. Many of the developing world's challenges do not present a commercial opportunity; consequently, little progress will be made without the help of governments, international development agencies, non-governmental organizations, foundations and universities. The role of universities is particularly important because solutions to the problems of the developing world are heavily dependent on new knowledge from research and creative application to local circumstances.

To choose one sector, problems vital to Third World health cry out for attention from the scientific powerhouse concentrated in North America, Europe and Japan. The record of the international pharmaceutical industry makes it clear that attention has not been forthcoming. Between 1975 and 1997 only 11 of 1,253 drugs registered by health authorities in the West were specifically indicated for tropical country diseases. A mechanism is needed to mobilize the power of the universities, small creative biotech companies and the research intensive pharmaceutical companies to address key developing world priorities for drugs, vaccines and diagnostic techniques which are affordable and simple to implement.

Nowhere in the developing world are the problems so overwhelming as in the countries of Africa south of the Sahara. Nowhere are general conditions which affect health such as poverty, clean water supply and female literacy so adverse and nowhere is the potential to respond through economic growth and political will so weak. The social fabric of South Africa and many of the other sub-Saharan countries is badly frayed by poverty, unemployment and the special problems of migrant workers dislocated from their families. Crime, violence and self-destructive behaviour flourish in an environment where people feel they have nothing to lose.

Superimposed on the economic and human development challenges is the devastating epidemic of AIDS. Of the 33 million recorded cases of AIDS worldwide, two-thirds are in sub-Saharan Africa. In countries like Zimbabwe, 25% of the adults are HIV positive. South Africa reports 1,600 new HIV infections per day; 40 to 50% of migrant workers are HIV positive. AIDS has a devastating impact on young adults and parents in their most productive and formative years. A quarter of pregnant women are HIV positive and 10 percent of pregnant girls under the age of 15 are HIV positive. One in three babies born of HIV infected mothers are afflicted by the disease. Ninety percent of the world's AIDS orphans are living in Africa.

We need to mobilize the scientific powerhouse concentrated in North America, Europe and Japan. Research is essential not only to discover effective drugs and vaccines but also to address social determinants of health and to design health delivery systems in societies with rudimentary infrastructure and major difficulties in achieving patient compliance.

There are equivalent opportunities in sectors other than health. The research capabilities of Canadian universities could make a profound difference. The impediment of distance has now been largely eliminated and virtual collaboration is possible with information and communication technologies.

To most of us, the problems of the developing world are remote. They enter our conscience only when dramatic floods, drought, famine or tribal conflicts are reported. We contribute to emergency relief but there is no sustained attention to help these countries provide for their people the most basic needs such as health. We hear of inept governments and corrupt administration. We tend to think their future is their problem, not ours. But with the progressive globalization of trade, financial flows, migration of people and communication we are increasingly related to each other in many domains including health and human security. The recent terrorist events are a vivid reminder that “The drama of our age”, as Michael Ondaatje writes, “is the coming of man into one fate”. Two million people cross national borders each day. Disease does not respect national boundaries and AIDS is a classical example. As Barbara Kingsolver notes in her novel, *The Poisonwood Bible*.... “Air travel, roads, cities, prostitution and congregation of people for efficient commerce – these are gifts of godspeed to the virus. Gifts of the foreign magi, brought from afar. In the service of saving Africa’s babies and extracting its mineral soul, the West has built a path to its own door and thrown it wide open for the plague.”

Now is the time for Canada to renew its distinctive approach to international development launched originally by leadership of the Colombo Plan and Lester Pearson's Partners in Development Report in 1969. Canadian universities have a contribution to make to international development well beyond what is currently supported by our development agencies, CIDA and IDRC. The universities, individually and collectively, need to articulate and promote a strategy to include international development research and education as an integral part of the Public Research Contract. The rewards to faculty and students will be substantial in professional experience, personal growth and breadth of horizon but the greatest satisfaction will come from improving the lives of more than half the world's population. Among the rewards to Canada will be the establishment of personal relationships and mutual trust with individuals who will be the future leaders of their countries and, perhaps most importantly, a contribution to international understanding and trust, the importance of which has been underlined by recent events.

CONCLUSION

We live in an era of unsurpassed intellectual excitement which places universities at the hub of future global economic and social development. Biologists have laid bare the human genome. Chemists create intelligent nanoparticles. Computer power is astronomical. Astronomers are at home with chaos, galactic and academic! The convergence of all derivative technologies is fueling the development of new ways of thinking, new horizons, new businesses, new ways of living and new ways of worrying about our stock market portfolios. All these new things present fresh challenges to the humanities, social sciences, ethics, management and law. We are truly in an era where so much of the frontier is at the interaction of disciplines, an opportunity the university should be uniquely equipped to promote.

With greater emphasis on the knowledge-driven economy, universities have unique potential to expand economic activity through discovery of new sources of wealth. To realize fully that potential, Canadian universities and governments should enter into a Public Research Contract which makes explicit the shared objectives and commitments to a long-term national purpose.

Why is a contract necessary? The commitment by universities to expand their research personnel and infrastructure would leave them extremely vulnerable if government funding of research were subject to capricious cutbacks or withdrawal. To justify the substantial expansion of funding for university research, governments need commitment from the universities to perform at international standards of excellence, differentiate their roles, use their resources efficiently and actively promote the commercialization of research results to achieve economic and social progress in Canada.

A roller coaster funding relationship will not serve the research investment interests of either party or the need to attract and retain sought-after faculty and students. Long-term planning and investment by the universities is essential for success. This requires the greater certainty of a Public Research Contract. Such a contract is central to the national economic interest. It could also enable Canada to renew its international reputation as a preferred partner in the developing world.

Universities have new opportunities and difficult choices, new partnerships and onerous responsibilities for execution. They cannot stand still. To succeed they must continuously improve their capability to provide their students and faculty with an environment for world class and world breadth discovery through learning and research. The prospect has never been more daunting but never so full of promise.

I conclude with an excerpt from The Hon. Paul Martin’s presentation before the federal Standing Committee on Finance, October 17, 1994.

“We must respond to the challenges in our times, as did previous generations of Canadians in theirs – the generation that put in place the physical infrastructure of the post-war economy, the Seaway, the pipelines, the highways, and the generation that followed creating the social infrastructure of a caring and compassionate Canada. We need that same will and wisdom today to create a new infrastructure for a Canada of ideas and innovation.”

Universities are central to that will and wisdom.



THE KILLAM ANNUAL LECTURES

- 1995 **Dr. David L. Johnston**
Chair, Canadian Institute for Advanced Research;
Former Principal, McGill University
*“Research at Canadian Universities and the Knowledge
Based Society”*
UNIVERSITY OF TORONTO
- 1996 **Dr. Richard A. Murphy, Ph.D.**
Director, Montreal Neurological Institute,
McGill University
*“Government Policy and University Science:
Starving the Golden Goose”*
UNIVERSITY OF CALGARY
- 1997 **Hon. Peter Lougheed, P.C., C.C., Q.C.**
Partner, Bennett Jones Verchere; Corporate Director;
Former Premier of Alberta; Chancellor, Queen’s University
*“The Economic and Employment Impact of Research in
Canada”*
READING ROOM, HOUSES OF PARLIAMENT, OTTAWA
- 1998 **Dr. Michael Smith, C.C., O.B.C., Ph.D., D.U., D.SC.,
LL.D., D.C.L., F.R.S., F.R.S.C.**
Peter Wall Distinguished Professor of Biotechnology,
University Killam Professor, University of British Columbia;
Director, Genome Sequence Centre, British Columbia
Cancer Research Centre;
Nobel Prize Laureate in Chemistry, 1993;
Career Investigator, Medical Research Council of Canada
“Science and Society in the Forthcoming Millennium”
HYATT REGENCY HOTEL, VANCOUVER

- 1999 **Dr. Björn Svedberg**
Chairman, the Royal Swedish Academy of Engineering Sciences
Chairman, Chalmers University of Technology, Gothenberg
Chairman, Canadian Swedish Business Association
Former President and CEO, L.M.. Ericsson AB
Former President and CEO, Skandinaviska Enskilda Banken
*“University Research as the Driving Force for the
Development of a Modern Nation in the Next
Millennium”*
PIER 21, HALIFAX
- 2000 **Prof. J. Robert S. Prichard**
Prichard-Wilson Professor of Law and Public Policy and Presi-
dent Emeritus, University of Toronto
Visiting Professor, Harvard Law School
*“Federal Support for Higher Education and Research in
Canada: The New Paradigm”*
ST. BONIFACE GENERAL HOSPITAL RESEARCH CENTRE,
WINNIPEG
- 2001 **Dr. John R. Evans**
President Emeritus, University of Toronto
Chair, the Canada Foundation for Innovation
Chair, Torstar Corporation
Chair, Alcan Aluminum Ltd.
Vice-chair, NPS/Allelix Bio-Pharmaceuticals Inc.
*“Higher Education in the Higher Education Economy:
Towards A Public Research Contract”*
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