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A Rationale for
Federal Funding of
University Research

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BACKGROUND

Since the mid-1960's there has been intense debate in Canada and other industrialized countries on how best science and technology can be fostered and managed in the service of man and in the national interest. From this debate has emerged a framework of science policies and structures for the organization, support and management of research and development in Canada. In 1971, a Ministry of State for Science & Technology was established.

An identified need to link government research establishments more closely with industry led first to the contracting-out policy, and the resulting transfer of part of the federal research effort to industry. Next, the decision was taken to reorganize the Granting Councils by separating support for university research from the other functions of the Canada Council and the National Research Council, so that the three Councils could focus exclusively on the objectives being sought for university research. The Act of Parliament making these changes was passed in June, 1977 and proclaimed in April and May, 1978.

A new Inter-Council Coordinating Committee (ICCC) was formed to provide the Ministry of State for Science and Technology and the government with an overview of the Councils' activities and advice on the allocation of funds. It is also to harmonize the granting practices of the Councils and provide a forum for discussion of interdisciplinary research and other matters of joint interest.

To facilitate an exchange of information with the provinces, and to develop recommendations on policies, programs and procedures, the Canadian Committee for the Financing of University Research (CCFUR) was established in 1976 with representatives from the provinces, universities and the Federal Government.

At the First Ministers' Conference on the Economy in February , 1978, the central importance of research and development (R&D) in industrial development was formally identified. In June of that year, the low level of industrial R&D in Canada was addressed in several new policies and measures, for although the proportion of industrially funded research in Canada had been rising to its present 35 per cent of the two billion dollars now spent on all R&D, it remained very low by comparison with other industrialized countries as a fraction of the Gross National Product (GNP).

The root causes of the low level of industrial R&D have been much discussed and publicized. They include the large number of foreign subsidiaries in Canadian manufacturing, which are in general not mandated to develop their own exportable products, and the comparative dominance of primary industries in the Canadian economy which do not demand a high ratio of research effort relative to sales.

As a result, Canada pays heavily for imported technology from which the initial large benefits have already been extracted, does not sufficiently develop opportunities for finished products for the export market, does not participate fully in the competitive market for innovative, skill-intensive, and high technology goods, and remains unable to fully absorb in areas of science and technology the highly-trained and skilled researchers and technologists in whom the nation has invested heavily.

Previous action by the Federal Government to improve the business climate and to stimulate privately sponsored R&D has included tax credits and allowances; special job creation programs for the research trained, both directly in industry and on industrial problems in universities; a commitment to utilize government procurement to stimulate R&D; and policies to lower the barriers to technology transfer and fuller cooperation between government and university researchers and industry. The latter included proposals to establish research centres focussed on national needs appropriate to the diverse regions of Canada, and university-based Industrial Innovation Centres to foster innovation and entrepreneurship.

In November, 1978, a first-ever Federal-Provincial Ministerial Conference on Industrial R&D agreed that MOSST, in consultation with the provinces, should develop a national program of action to stimulate industrial R&D. This mandate was later endorsed by First Ministers.

More recently, the government has announced a national R&D target of 2.5 per cent of GNP which will place new demands on the universities for scientific and technical information and skills of national interest and for research-trained manpower. The government is considering the proposed five-year plans of the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC) and the Medical Research Council (MRC).

The 1970's were a time in which the costs of research rose very steeply while expenditures on R&D of all types remained nearly constant in real terms. The research activities of universities suffered significant erosion as a result. At the same time, the era of rapid growth in student enrolments came to an end, the flexibility in hiring new university faculty was much reduced, and faculty members themselves had less mobility so that the university research community is now seen to be relatively static and gradually ageing. There have been discernable shifts in the career choices of able students away from research fields, as the full complement of highly qualified manpower recently graduated from universities was not absorbed into fulfilling roles in the Canadian economy.

This is the context in which this background paper has been prepared. It is being presented as a preferred approach to the support of university research in Canada. For efficiency alone, any expansion of national effort in R&D should be built upon what already exists. Universities embrace about 25 per cent of the national research capacity in terms of annual expenditure, and a large fraction of the available research-trained manpower. One of the central questions is how the university research capacity with support from both orders of government, as well as other sources, can help foster a movement towards a stronger and more integrated national effort in R&D.

A draft of the paper was sent to the provinces and their comments have been taken into account. The paper, does not, however, represent their views in any way.

RESEARCH AND THE NATIONAL FUTURE

Science (taken to embrace the whole range of studies from humanities to engineering, including the human, life and natural sciences) can be defined as the creative acquisition and application of knowledge. As such, it is one of the principal means of defining and achieving a desirable human future. Science can provide a range of feasible options and choices. It can also provide a factual basis for options by assessing the probable consequence of new technological and social practices.

Farsighted investment in research must therefore be adequately provided for, in a world where governments' preoccupation with short-term issues might otherwise mean that the future may be left to look after itself. Yet the future is acquiring more and more pressing significance in today's society. Deep and widespread

concern during the 1970's about the environment, pollution, land-use, fresh water, and energy has created a new consciousness among the public about long-term issues and the impact on them of science and technology. This new consciousness has come less because of immediate and severe shortages than because of the threat of future uncertainties. Science and technology, although undoubtedly responsible for some of the problems we face, are also responsible for much of our well-being and prosperity. Wisely used, they can define and provide for a secure and desirable human future.

The success of the Canadian effort in science and technology will ultimately be judged against the international standard of scientific excellence and the world marketplace for innovation. In considering what the priorities for the support of science should be, an important consideration is that Canada now undertakes only about 2 per cent of world annual expenditure on research and development. The first and most obvious priority is therefore to maintain access to the other 98 per cent of the growing world stock of knowledge. To draw from this stock we must be visibly contributing to it. This is the basis of the need to maintain excellence and a healthy capacity in all the disciplines of scholarship. Next, we manifestly cannot rely on imported knowledge to tell us about our own society and cultures, nor to capture international leadership in suitable areas of science and technology. For this, we need specialized and enhanced capabilities.

What type of such further investment in research should we be making, having provided such a basic capacity to know and do? The unique Canadian factors that offer special possibilities and opportunities include: access to three oceans, the longest national coastline in the world, a rich and diverse natural resource base in minerals, food, forestry and energy, an extended geography, a people of two languages, many origins, and diverse cultural histories, a scattered population, a climate that places us on the margin of the habitable and food-producing world, and an exemplary role in world affairs as a developing nation within the developed world, an acceptable mediator and an international donor. From such a list it is easy to derive a broad set of priorities for science and technology: communications and transportation, oceanography and ocean management, agriculture, fisheries, forestry, mining and materials, energy production and transmission, energy efficiency and conservation,

cold-water, ice and cold weather technology and so on. There are parallel implications for health research, work safety and types of international aid. There are questions of constitution, languages and intercultural relations, the problems of coordination of effort and effective collaboration by governments in a federal system, the issues of labour relations, a changing work force, and an ageing Canadian population. From such lists in turn can come a range of national research objectives, many especially appropriate to a particular region and its natural and human resources.

There is another important dimension represented in the opportunities afforded by sudden advances in science and technology (electronics and genetics providing current examples). It would be wise, however, to focus on those aspects that are fully appropriate to the Canadian context outlined above. This should enhance the chances of capturing a lead (remote sensing, telecommunications, navigation systems and agricultural engineering are obvious possibilities arising from the examples above). Of course, if research expertise were already concentrated in areas of national priority this selection would arise spontaneously from the predilections of the researchers themselves.

Priorities change with time as governments take action on major problem areas, but there are underlying problems, and opportunities which require long-term and sustained research effort. These are the appropriate ones for concerted research in universities.

Although this paper places some emphasis on research in natural sciences and engineering, there are major implications and opportunities for every branch of scholarship. GERD (gross domestic expenditures on research and development) is a statistic for international comparison which includes natural sciences, engineering and health research but not research in the humanities and social sciences. Yet, as GERD increases, it can be assumed that the pace of technological and therefore social change will also accelerate so that arguments for parallel effort in the human sciences are fully justified. Further, the growth of new industries and technologies requires continuous assessment of social, health and environmental impacts.

The whole process of identifying and achieving national goals through research investment is itself an activity requiring an interchange of views and

understanding between the political expressions of public priority and the state of knowledge and abilities of the scientific community. Scientists may thus be called upon to play new roles as part of an interactive exchange in which the external goals for science - what government or the public might wish to see achieved - must be matched realistically with the internal goals of science itself.

The R&D component of national issues, when aggregated, represents the national "need" for science and technology, to be reflected in manpower and funds directed at these objectives. When disaggregated, this R&D component identifies by sector the existing priorities for and directions of research in the different activities of science. In seeking to realize national objectives, effort is needed by performers in government, industry and university. As science objectives acquire priority, they must be realistically funded (the United States could not have gone to the moon without the additional resources expended to do so). In the process, existing capacity needs to be reoriented and new activities and new capacity generated as required.

The central questions to which answers are gradually being developed for the optimum deployment of R&D effort are of the following type:

i) What represents sufficient investment in the indispensible infrastructure of fundamental research?

ii) What are the priorities for concerted research effort and how and by whom should they be set?

iii) In the three sectors, government, industry and university, who should do what R&D and how much?

iv) How can the research in government and university best be interfaced with industry and society so that the maximum potential result is realized?

v) How can we best capitalize upon the diversity of regions across Canada?

Full answers will require consultation among governments and with the industrial and university research communities.

THE ROLE OF UNIVERSITY RESEARCH

There is a need for new knowledge that can only be fully met by an investment in research activity in universities. University research is also the principal means of training research manpower. In an increased national R&D effort, the need for research managers, researchers, technologists, technicians and craftsmen is as significant as the need for higher dollar flows, although the latter represent the normal means by which such effort is recorded.

There are convincing arguments that a proportion of research must be unconstrained so as to provide for the unexpected breakthroughs and for the response to new priorities and problems as they arise. If all research were to be orchestrated according to today's perception of tomorrow's priorities, the ability to respond to new priorities would be impaired. Ten years ago it would have been impossible, for example, to have predicted the 200-mile ocean limit for Canada, and the resulting consequences for science. Water shortages in the United States may make a Canadian water policy a key factor in Canada-United States relationships. If water research were declared "unimportant" now, this problem might be aggravated, and the government would perhaps be "blamed" for its lack of clairvoyance. No one can precisely predict what the 1980's will bring. The ability of Canada to deal with the future will, therefore, depend to a considerable degree on the health of fundamental research and scholarship in its universities.

Nevertheless, although science moves by random walk or fortuitous discovery, there are enough historical "demonstration projects" to show that this walk becomes a concerted and directed run when an objective is properly enunciated. To science, for example, the Second World War posed the objective "beat the enemy". Based on underlying fundamental discoveries and technologies already evolving, science provided in a five-year period: computers, television, radar, jet engines, rockets, antibiotics, vaccines, surgical wonders and atom bombs. The war effort accelerated the process of innovation by several orders of magnitude.

No one can therefore claim unchallenged that science is best left entirely to itself. Much basic science can be done and brought to fruition within the context of national priorities, providing the underlying research capacity is in good health.

This is not to say that universities should do the research that industry should do. It is not to say that basic research and non-directed research should be abandoned in favour of applied and mission-oriented research. It is to argue, however, that some appropriate balance should be struck in universities between the maintenance of a basic capacity to know and do, and the utilization of that capacity actually to achieve what needs to be done in terms of Canadian problems and opportunities.

Based on these perceptions of the role of science and technology in the nation's well-being, and of the integral part to be played by university research, the Federal Government has identified three main aims for the federal support of university research in the national interest:

i) to support fundamental research in order to advance knowledge - this can be viewed as the infrastructure needed to support the concerted programs and maintain the flexibility required to adapt to changing demands;

ii) to institute concerted research programs towards identified scientific goals within national priorities established through the political process; and

iii) to support and develop research-trained manpower which can participate in both concerted programs and fundamental research programs, and feed naturally into the economy.

These aims provide a framework for the realization of the objectives which underlay the reorganization of the Granting Councils.

The objectives were:

i) to support and foster excellence in research;

ii) to provide a base of advanced knowledge through encouragement of curiosity-oriented research;

iii) to encourage research which would contribute to national objectives;

iv) to encourage interdisciplinary research;

v) to ensure regional balance in scientific capability;

vi) to assist in the focus and concentration of research activities and facilities; and

vii) to maintain a basic capacity for research training.

The restructuring of the Granting Councils resulted in:

i) The Natural Sciences and Engineering Research Council (NSERC), with responsibilities transferred from the National Research Council;

ii) The Social Sciences and Humanities Research Council (SSHRC), with responsibilities transferred from the Canada Council; and

iii) The Medical Research Council (MRC), with a mandate no longer excluding health care.[1]

That some change in the support of university research is due is not an indictment of past practices, but more a product of the rapid evolution of universities, the soaring costs of research, and the necessity of choice alluded to earlier. There is a pressing need to marshall the available forces and focus their efforts on chosen issues in order to realize excellence on a world scale. There is evidence to indicate that in almost all disciplines, the requests amounted to double the available funds. The number and size of requests submitted indicate a willingness and capacity on the part of the university research community to expand their activities. Selection of priority areas will be dictated by special national and regional needs and problems; others can arise unexpectedly from the opportunities presented by new discoveries. Even the latter, however, can be concentrated in areas of national and regional priority, if excellence and enlarged capability in those areas is systematically fostered and provided for.

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1 Although the mandate of MRC no longer excludes health care, Health and Welfare Canada remains the sole federal departmental supporter of health care research.

CONCERTED PROGRAMS AND NATIONAL GOALS

A concerted program is a collective research activity, perhaps involving many researchers and many disciplines, working towards a realistic scientific objective related to a goal or priority lying outside science itself. It therefore involves more than the research activities as ends in themselves, in that the results are coordinated and inter-related so that the final objective can be reached.

A distinction has been made in this paper between fundamental research and concerted research programs[1]. Both categories can contain components of basic research and applied research.

The important distinction is that fundamental research arises solely from the investigator's personal interests and curiosity, whereas the research in concerted programs is somewhat more directed in that an investigator is asked to contribute towards the attainment of some more or less broadly defined objective. In both cases the investigator is free to design his own program and make his contribution in an optimum manner; the difference is that there is a presumed "customer" for the second kind of research who has made his requirements known.

Concerted programs would involve varying mixtures of basic research and applied research, depending on the state of knowledge and the scale and type of effort to ready some possible option for implementation. Similarly, some of the fundamental research would be of an applied character, as in branches of engineering, but unconstrained by any directive or assigned objective. Either category may or may not be interdisciplinary, although concerted programs are likely to foster greater levels of interaction among specialties.

The key difference is the way in which the research is defined and managed. Fundamental research success relies solely on the judgement and motivation of the researcher, and its continued funding depends upon the value placed on his or her results by peers.

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1 It should be noted that confusion between French and English terms could arise because fundamental research translates as "recherche libre", while basic research translates as "recherche fondamentale".

Concerted programs, on the other hand, require not only peer assessment but also a defined goal or priority under which certain scientific objectives can be identified and explored through research.

National goals are broad statements of desire. They are political statements in which the values and aspirations of Canadians are matched against the social, economic and resource potentials of the country. In the Canadian federation the identification of priority issues appropriate for science and technology to address involves a process of consultation in which regional priorities and needs are integrated with those of the country as a whole. This process of consultation among governments, as mentioned earlier, has already begun. Goals derived in this way are not absolute or immutable and are not mutually independent. Broadly stated national goals are, however, unsatisfactory as targets for concerted research effort. Rather, they form a framework from which a set of more precise scientific objectives can be formulated. When properly enunciated, these more precisely defined objectives act as a mirror against which any scientific research proposal can be reflected and assessed.

The definition of scientific objectives should be an iterative process in that defining attainable and realistic objectives helps to define priorities and refine goals. This should produce a feedback system between the scientist and the policymaker, and between the feasible and the desirable. The process will be improved if the differing perspectives and special expertise of federal, provincial, industrial and university sources are adequately shared.

The Granting Councils, fostering the research capacity of the university research community may, having selected particular priorities for emphasis, favour the longer-term options as objectives for support through concerted programs. As the results develop more immediate promise of implementation, further work might well be undertaken or sponsored by government departments or by industry. If sponsored in the universities, research at this stage of evolution would then shift in the direction of contracts with the new sponsors.

Most of the federal funding of university research is provided through the three Granting Councils, and consequently, in this background paper we have concerned ourselves mainly with the Councils. However, other

federal departments support university research, much of it mission-oriented, and these departments will be among the sponsors of contract work.

Each Granting Council serves different constituencies and has developed different systems of support. Each, therefore, would develop its own interpretation of concerted programs applicable to the fields it supports against a background of priorities derived from the political process. They may also collaborate on some programs so that the cultural, social, medical, scientific and engineering aspects of issues can be simultaneously addressed.

In addition to the new mechanisms for university research that would evolve in order to establish and manage concerted programs, new indicators of performance and success will be required, not to replace, but to extend the criterion of excellence now involved in peer review. Progress towards national goals, the buildup of significant research concentrations, job creation resulting from technology transfer, innovation and entrepreneurship, and the growth of regional balance in the aggregate distribution of research capacity should accompany international excellence and the random "breakthroughs" of fundamental research as the hallmarks of success of the research effort in universities. Measures to assess these additional factors could become part of the evaluation criteria of the Granting Councils for grant applications (as appropriate under different funding programs) which would help tailor the reward system towards the new objectives being established for university research.

FUNDAMENTAL RESEARCH: MAINTAINING A BALANCE

Development of concerted research programs related to national goals would represent a considerable reorientation of university research. Yet the policies and programs of the Granting Councils prior to 1977 were already achieving a gradual change towards such challenges and opportunities.

Retrospective analysis of awards reveals a number of areas of national concern which were being supported, and significant concentrations of effort which were being built up. The funds for research in areas of national concern added by the government to Granting Council budgets in 1977 and 1978 were important further steps and the experience from these suggests that university researchers would support such a reorientation. If existing efforts could be

identified, managed, and orchestrated in concerted programs towards national goals in a deliberate and planned fashion, a first move towards the establishment of concerted research could be accomplished. In some fields, however, the base of fundamental research is still underdeveloped and would need to be significantly enhanced before this could be undertaken.

Some departure may be desirable in Canada from the pattern of individual operating grants, in favour of expanded efforts by groups and teams. The Granting Councils, to varying degrees, already sponsor this type of activity. The "critical mass" of related effort necessary for a breakthrough in most fields of scholarship seems well recognized and documented. Again, the establishment of concerted programs would be a major step in this direction. Properly funded and managed, these programs could help link researchers even in distant universities through visits, workshops and exchanges.

Federal support of university research through the Granting Councils, as well as provincial investments in facilities and human resources, have built up a solid foundation of research capacity in Canadian universities in many fields and disciplines. It is both logical and legitimate to build upon this base a nationally coordinated and managed research effort in areas of national concern.

Basic research and fundamental research as defined here are not the same. Basic research can flourish within concerted programs. It would not be justified, therefore, to claim that the concerted programs should be built exclusively by adding to what already exists. Part of the existing research activity, which includes basic research, might necessarily have to be reordered, so that it can be recognized and managed in the new context.

What is the correct balance of fundamental and concerted research in universities? Logically, most of the national effort in fundamental research should be in the universities: leading experts reside there, they are training new manpower, and they are the "front line" of Canada's international science effort. It must therefore be sustained at an adequate level. The priviledged kind of free enquiry represented by fundamental research is supported by public investment as necessary for a healthy infrastructure for any kind of more directed or managed effort. It could be

argued, as an infrastructure, it should be capable of supporting larger scale activities, so that the cost of fundamental research may turn out to be less than the cost of concerted programs in the university research community.

With no absolute measure of what the optimum balance between concerted programs and fundamental research should be, only experience will provide the answer. As the scale of such research activities increases, the Councils will be able to monitor the balance and act to ensure that the pendulum of change does not swing too far.

The establishment by the three Councils of concerted programs within their proposed five-year plans will allow individual university researchers to identify the options they have and seek to optimize these for themselves. For many, it should encourage the creation of teams and groups within concerted programs. The need to provide an adequate level of support for the most outstanding researchers pursuing fundamental research objectives will intensify the competition in such programs, and thus help to foster world class excellence in this type of free enquiry.

OTHER FACTORS

a) Manpower

In aggregate the number of graduate degrees awarded in Canada has expanded somewhat through the seventies, mainly at the Master's degree level. PhD enrolments have fallen slightly and the numbers of PhD degrees granted have remained constant at about 1700 per year. But within these total figures, there have been very significant shifts away from the traditional research fields of health sciences, physical sciences and mathematics, partly towards professional degrees. The current oversupply of research personnel in some fields is thus being naturally compensated for by the career choices being made by today's students.

The Federal Government is presently seeking to stimulate employment and the economy through generating increased efforts in industrial R&D. A problem of underemployment of graduates and research-trained people exists in some fields of study, while in other areas there is a shortage of graduates. Increased R&D in support of national economic and social policies will require an appropriate supply of research-trained manpower. If a corresponding demand from industry

develops, the present pattern of graduate enrolment may alter rapidly.

It is likely that this demand would not only be for new graduates, but also for research managers and senior researchers able to lead. These may well be drawn from university and government where most of them are now concentrated, offsetting the static nature of employment in these sectors and the collective "ageing" of university faculty, and creating opportunities for young and excellent replacements.

Although the focus of the thrust for more R&D is necessarily on industry, universities are deeply involved. If new jobs are required they will arise from doing new things. The chain of relationships can be followed from job creation arising from innovation, innovation arising from development, and development arising from research.

If the subjects of concerted programs are wisely chosen, the graduate students and research associates involved would naturally acquire an orientation towards potential job markets in areas of economic growth. Many of these would be in industry and government, however, replacing the traditional professional positions for which many graduate students were previously trained. Academic faculty positions are likely to be in very short supply until the 1990's.

Concerted programs would also create an important reservoir of already trained researchers simultaneously acquiring an appropriate orientation for subsequent employment. Research associateships and post-doctoral fellowships in concerted programs could facilitate the transfer of people from one specialty to another and the acquisition of interdisciplinary skills.

In this way concerted programs would contribute considerably to the objectives sought through the reorganization of the Granting Councils stated earlier. In addition, the following problems would be addressed:

i) the current mismatch of supply and demand for highly trained research manpower in some fields, in relation to national needs;

ii) the maturing of the research community due to tenured or permanent employment in a period of no or slow growth;

iii) the dominance of discipline-oriented and individual research, which deters interdisciplinary and group research activity;

iv) the lack of stability and support for university research in terms of long-term planning and continuity. Coupled with the decline in the level of support, this has caused uncertainty within the academic community;

v) the difficulties in transferring ideas and inventions from universities to industry; and

vi) the underutilized capacity for research in universities. This assessment is based on the ratio of amounts requested to amounts awarded.

b) Innovation

It is not an exaggeration to credit the growth of innovative and high technology industry in New England and California almost entirely to activities begun on the campuses of the Massachusetts Institute of Technology, Stanford University and the California Institute of Technology. In some cases industrial innovation was fostered by the establishment of industrial parks or the creation of special institutes or laboratories, of which the Stanford Research Institute (SRI) is perhaps the most notable example. The emphasis has been on new ideas and innovations, and only more recently have major manufacturing companies become heavily and directly involved in university research.

In Canada, there appear to be several factors which presently deter entrepreneurial activity by university faculty. It would be beneficial if universities and the Granting Councils could examine such questions, although innovative and entrepreneurial activity is already beginning on many Canadian campuses. Several universities have established research parks, several have invention assistance programs and applied research institutes, and many are actively seeking industrial contracts. The government has recently announced start-up grants to finance Industrial Innovation Centres at the University of Waterloo and the École Polytechnique.

Industrial Innovation Centres are intended to capture and combine the diverse skills already available on

campus in law, finance, management, marketing, science and engineering, so as to study innovation and entrepreneurship, and provide training in both. They would function as a window out from universities towards industry, facilitating the transfer of inventions and ideas, could provide capital for development, and would seek venture capital for development to production. They would provide a central access point for industry into the network of ongoing university research activity, and thus help to lower the barriers between sectors. Increased attention by universities to concerted programs will enhance the universities' ability to provide vital information and advice to industry.

c) Regional concentration and specialization

Canada is a small country in terms of population and economics, and a vast country in terms of geography and opportunity. Thus, fostering a regional balance of capability and well-being is a central priority of the Canadian federation. Regional specialization offers an important means of balancing research capacity in Canada in significant concentrations, and of lowering the barriers to technology transfer by creating a regional network related to innovative industrial development.

Universities are conspicuous centres of expertise across the country and thus important elements in this balancing process. They could also become, with the right kind of support, a part of an integrated effort for innovative regional economic development, by choosing to concentrate research on the special opportunities arising from the diversity of natural and human resources across Canada as described earlier in this paper. Might we not systematically strive for critical masses of activity with different specific objectives in specific regions, arranged so that the effect, when aggregated, is balanced across Canada? For university research, would this diversity not be preferable to the relative uniformity we have now? Early reactions seem to indicate so.

CONCLUSION

This paper is put forward as a statement of the general framework and rationale for the federal financing of university research through the Granting Councils. It describes the background against which the rationale was developed. It also outlines the

range of factors that it is thought should be taken into consideration by the university research community, the Granting Councils and governments in developing their response to the challenging problems and opportunities for science and technology in Canada.

A review of the role of university research is called for by the evolving public perception of the role of science in society and the emerging national role of R&D. The somewhat more deliberate and orchestrated effort called for in this paper need not detract from excellence, nor sap the strength of basic research. The last few years have seen significant movement in the directions described. This paper suggests that it be developed further, in a context where the research community plays a vigorous role in the establishment and realization of desirable objectives. All sectors should be involved in defining and working towards these objectives in an iterative process which will produce an interchange of information and ideas between the scientist and engineer and the policy-maker.