



# THE ROYAL BANK OF CANADA

HEAD OFFICE, MONTREAL

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**T**HE material history of man is the record of a hungry creature seeking food, and finding, generation by generation, better and easier ways of keeping himself alive. This Letter deals with the research that men are making into the originating of new goods, and the production of goods in improved ways, with less expenditure of labour and capital.

One grievous error made by many people in thinking of the peace which is to follow this world war is that victory will bring Utopia along with it. No approach to the post-war period could be more perilous. Progress will still require effort in any new world. Old methods of scientific enquiry have been revolutionized, and sciences have been created that were undreamed of by the boldest thinkers of yesterday. There is no room in a forward-looking society for the slumber of fixed opinions, static methods, and unoriginal plans.

At the same time, mankind must not be carried away by things which are attractive merely by reason of their newness. While much of the old fantasy has faded because of its childishness, there are new and more subtle forms endeavouring to lure humanity behind a dozen kinds of Pied Piper. We laugh at Ponce de Leon and his search for the fountain of youth, yet many people are still looking for marvels; magic monetary schemes to remove the necessity for working, magic foods and pills that will prolong life, magic knowledge that will transform personality, shortcuts to avoid the real toil of learning, and incredible machines, gadgets, and systems of all kinds. It is imperative, in the interest of Canada, that a clear middle path should be found by government, industry, educationalists and individuals between the idea that new truths may have been desirable once, but that we have had enough of them now, and the gullibility that sees miracles in every retort and a prodigy in every new product.

The Schoolmen shook their grizzled heads over the antics of Roger Bacon, who dragged specimens into the classroom for examination under magnifying glasses, instead of reading about them. That was research. Research extends all the way from Junior, in his basement toying with his chemistry set, to highly integrated laboratories in our universities dealing with pure science. If certain obstinate students had not insisted on studying subjects which the great wise world disdained as perfectly futile, we should have no bathrooms, flying machines, cure for diabetes or preventative of diphtheria. Research, because it brings comfort and convenience into all our lives, has overcome doubt and scepticism. It has taught man that he is not the creature of circumstance, but can make circumstances. And yet it is necessary to urge that more be done in its support, if this country is to maintain its eminence in the world of progressive nations.

Our national development depends upon the building-up of additional new industries, broadening the prospects for employment of labour and capital. Canada's present prosperity is built upon unusual foundations. She is supplying many markets that ordinarily take their goods from nearer countries: e.g. the British market for bacon, butter and cheese. She is giving away huge amounts of her products by way of mutual aid. She has pushed her exports to more than twice as much per year as ever before, but 80 per cent is made up of purely wartime goods.

Every avenue must be explored to find new ways of doing things and new things to make. Only by continual advancement can industry maintain its system of enterprise, in which individual initiative finds its greatest reward. A committee of the Federation of British Industries, under Sir William Larke, reached

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this conclusion: "The application of research is a certain means of increasing employment by the improvement of existing and the creation of new industries; conversely, the lack of it spells stagnation and ultimate bankruptcy."

Great development has been made in wartime, and no one can tell to what extent Canadian industry is now engaged in research. Much of it is for wartime purposes, and is on the secret list, though a great deal will be available for orientation to peacetime uses. However, it is not likely that Canada has advanced relatively farther than other countries, and these figures, given in the House of Commons by the Minister of Trade and Commerce this summer, present a striking comparison of Canada's relative position in expenditures on research:

Country	Date	Annual Expenditure in million dollars	Annual Expenditure per capita	Expenditure as % of National Income
Russia	1934	300 to 500	\$1.82 to \$3.	.8 to 1.0
United States	1935	300	\$2.40	.5 to .6
Great Britain	1934	30	.70	.15
Canada	1938	2.4 to 3.3	.22 to .29	.06 to .08

The Canadian figures, said the Minister, cover all research, private and national.

In commenting on the table, the acting president of the National Research Council said it is a sound deduction that "Russia, Germany, the United States and Japan were all devoting relatively large amounts of their pre-war income to research; that Great Britain was far behind quantitatively, although it was known that quality was very high; and that Canada, on any proportional basis either of population or of national income was spending not more than one-eighth to one-tenth of what Russia and the United States were allotting to research, and probably not more than one-third of Great Britain's expenditure. Although Canada's population is one-tenth that of the United States, its research expenditures were only one-hundredth; Great Britain's total expenditure was over ten times Canada's, although its population is only four-fold."

Key agency in Canada is the National Research Council, established in 1916. It operates a dozen laboratories; it acts as adviser to various departments of government; and its third and most important function is in connection with the arranging and co-ordinating of national co-operative research programs in which various departments and organizations have an active interest.

Much of the work is done at universities, all of which are in touch with some of the problems being tackled. Dr. Cyril James, Principal of McGill University, suggested to the Social Security Committee that there might be built up a closer liaison between the general public and the research scientists. The objective would be to create in the public mind a

recognition of the fact that the universities work in concert with the National Research Council, and to encourage business men in Vancouver, for instance, to go to the University of British Columbia for help with problems that should be handled there, with the understanding that if not solved in British Columbia they would be passed on to the Research Council.

The Ontario Research Foundation was established in 1928, an endowment fund being created by subscriptions received from manufacturers, corporations, and private individuals, and contributions by the Provincial Government on a dollar-for-dollar basis. The National Chemurgic Committee was organized under auspices of the Chamber of Commerce as a national activity dedicated to the creation of new wealth and opportunity. The Chamber's Agricultural-Industrial Committee, appointed in 1938, was charged with considering practical steps to find new and expanded markets for farm products. There are a great many other research projects under various departments of government: the Geological Survey, the Topographical Survey, the Department of Mines and Resources, the Dominion Observatory, the experiment stations of the Dominion Forest Service and the Department of Fisheries, all seeking to develop or apply Canada's natural resources to the welfare of the people. In the year before the war Canada had approximately 1,000 industrial laboratories employing 2,500 professional and 2,700 non-professional workers, with a total investment in laboratory buildings and equipment of \$10½ million. Most of these laboratories, however, were engaged chiefly in plant control and testing work, as distinct from original research.

Agriculture requires particular attention, and highly trained specialists of the Dominion Department of Agriculture are continuously at work in laboratories, testing plots and experimental farms. Believing it essential that there should be an expansion of research work for the utilization of agricultural crops, the Minister of Trade and Commerce announced a few months ago establishment of a laboratory in western Canada to seek means of using farm produce, particularly surpluses.

Wheat, the big Canadian crop, is one of Canada's great perplexities. Surprisingly little has been done in the field of seeking new and expanded uses for wheat, both because in most years there is little difficulty in disposing of the crop for food, and because of the natural characteristics of the grain. Just how important a crop can be in the way of yielding cash for farmers through off-the-farm utilization is indicated by the United States' use of corn. More than 80 million bushels are being consumed in industry, and while this represents only 3 per cent of the total grown, it constitutes 33 per cent of the farmers' cash sales of corn, the balance being used for feeding livestock.

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One significant development of the war has been the mastery achieved over dehydration. Research in this field started primarily with the idea of conserving shipping space in the dark days of submarine warfare, but so great progress has been made that the use of dehydrated foods for domestic consumption seems to be assured in peacetime. A dozen eggs can be dehydrated and compressed to the bulk of one. One ship-load of dehydrated food is equivalent to 16 ships loaded with bulk foods. Application of dehydrating processes will mean that the housewife may purchase out-of-season vegetables in compact packages for storing on her pantry shelves, and assurance is given that there need be no loss of flavour, colour or vitamin content.

In the general field of post-war prophecy Mr. and Mrs. Citizen are being led to anticipate a great many gadgets, gleaming light metals, colourful unbreakable plastics, mysterious radio waves and 500 mile-an-hour transport, all of which add up to a somewhat dizzy world. It is true that radionics, electronics, radar and all the other magic words are in a fair way to being implemented for general use through the research of industry and industry's initiative and facility in adapting their wartime uses to the benefits of peacetime, but it is possible that there may be too much talk about the "glamour" kinds of discovery. The public would do well to discount the enthusiasm of crystal-gazers, and should not expect too many marvels too soon. Chemistry and physics are not miracles. Chemistry is the taking of some of a relatively small group of basic substances and so combining them that they assume new forms and new properties of use to mankind. Physics progresses through applying different forms of energy to matter. They are practical sciences, advancing slowly on the whole, but sometimes in great bounds, under the hands of skilled scientists.

Canada has found a great shortage of scientific workers, and far more will be needed in the future than this country has hitherto produced. We shall likely have to rely upon our own efforts, because every other country will be equally desirous of advancing research. No youth can hope, in these days, to progress far in science without thorough training in fundamentals, and university education seems to be basic. Herein lies one of the great problems of Canada's federal system. One Canadian province spends \$31.70 per child on education, while another spends \$83.38, two and one-half times as much. This means that in so far as elementary and secondary education and preparation for university are concerned children are penalized by being born in one part of the country rather than another.

Educational leaders in Canada have at all times co-operated eagerly with the government in every contribution that could be made to the war effort,

and the universities have given their resources unreservedly. It is from these universities that the research workers must come, but in addition it is in the universities that the pure research upon which applied science works must originate. This pure science is not something which is expected to have immediate specific application, but is a seeking-out and storing-up of scientific knowledge which may be drawn upon to help solve problems as they arise. In consideration of the importance of the contribution the universities can make to the stability and advancement of the country it is an important duty to see that university staffs, stipends, buildings and equipment are all of a grade high enough to retain the best scientists. The story of university research, when it can be told, will be a notable chapter in Canada's war effort. Under pressure of war the university laboratories have expanded both in material means and in breadth of ideas. During quarter of a century these laboratories have passed from the era of simple microscopes, sealing wax and string in which their early triumphs were gained into one where the most complex instruments and machinery are necessary. The field of university research is as broad as science itself, and will be limited only by the facilities at the disposal of individual institutions.

Establishment of a large number of graduate scholarships to develop highly-trained industry's research personnel is imperative if Contribution Canada is to be enabled to hold her place in the post-war world. It is not fair nor is it efficient that the men doing important basic scientific work should have to go cap-in-hand to individuals or organizations seeking funds with which to obtain apparatus and facilities. Some people have suggested that federal grants should be made to universities in each province to assist in providing research laboratories for study of the special resources of each province. There is need of a generous attitude by industry. Some scientists fear that grants for research might be associated with demands for routine services, or that investigations might be limited to certain fields. The late Lord Melchett, whose firm gave extensive support to the university laboratories of Great Britain, said his company expected in return only ideas and good men. In the past industry was too much inclined to apply the law of the Locrians, who demanded that the proposer of something new should stand before the assembly with a halter round his neck, to be instantly tightened if the public did not then and there approve his proposition. Greater latitude than that must be allowed the scientists; whose very first requirement is that their spirits should be free to search in hidden places for what new things nature may still have to yield.

Many companies have prospered without research, but a glance over the record will show a still larger number which passed quietly away, expiring for sheer lack of new ideas, while their proprietors railed against the march of progress and hard times. On the other

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hand, some Canadian industries have been getting along fairly well on imported research, but this is not likely to continue on the same basis at the war's end. Canada is so industrialized today that her needs will be similar to those of the United Kingdom, the United States and other industrial countries, and she cannot expect these competitors to supply her with their newest scientific developments unless she, in turn, is providing them with worthwhile discoveries from her own laboratories. Dr. C. J. MacKenzie, acting president of the National Research Council, emphasized this in a recent address when he declared: "Apart from the contributions of universities and government laboratories, Canadian industry, with a few notable exceptions, was existing on technological blood transfusions from Great Britain and the United States." In Great Britain in 1934 industry was responsible for about 33 per cent of the total expenditures on research, while in Canada only from 5 to 7 per cent of the relatively meagre total expenditure on research was made by private industry. It is not suggested that every industry should immediately establish a large research department, but it should take stock of its position to ensure that it is devoting to research and development the effort and funds needed to cope with its particular problems.

It will always be necessary to have industrial laboratories study immediate subjects such as the reduction of manufacturing costs and the improvement of production, but it will be increasingly important for industries to pursue a more fundamental type of applied research, to augment similar work and research in pure science being carried on in universities. Industry can help the universities by indicating projects which are most likely to be useful, by providing funds and by showing initiative in developing promising results given them by university laboratories. Industry can further help the cause of research and improve its own position by calling in scientists as advisers and experts in the policy-making stages of business, and not only as doctors to prescribe treatment after trouble has developed.

The Parliamentary and Scientific Committee of the British Houses of Parliament has just brought in a report declaring, "We should certainly look forward to spending (on research) at least 10 times as much annually after the war if we are to provide the basis without which neither our agriculture nor industry can effectively meet the needs of the future." If we translate this into terms of Canadian needs it will mean the annual expenditure of at least \$50 million, or from 15 to 20 times the pre-war rate. This scale could not possibly be reached within the immediate future, because Canada could not find sufficient scientifically trained personnel. Dr. MacKenzie gives as his opinion that, with all the available personnel at present engaged, the annual expenditure is not greater than \$10 million. He suggests that Canada should maintain in the immediate post-war years her present over-all scale of expenditure on research, and look forward to increasing this year by year as trained personnel becomes available.

Research is slow. The processes by which acquaintance is gained with the universe appear to limp along. The detection of another asteroid, the discovery of a new composition of chemicals or an application of physics hitherto unknown to science would be but trifles if each new fact remained alone. The glory of science in its benefaction to mankind lies in the blending of all that learned men uncover, and translation of the new truths into expansion of human life. The greatest mistake Canada could make would be to brush aside research as unnecessary or wasteful, or rely wholly upon other countries, or disregard the discoveries of science, losing herself along other avenues of effort. It is appropriate to recall that while Watt was experimenting with the steam engine Adam Smith wrote "The Wealth of Nations", in which he referred slightly to the inventor's production as "a fire engine", and dismissed it from his calculations. Yet this product of a Scottish inventor's mind was destined to upset all the economic processes the world had evolved, and reshape the lives of men.



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