

that stagnation prevailed, for the 1961 level of \$115 million is only slightly higher than the 1956 level of \$110 million, without allowing for inflationary cost trends. During the same period, industrial output rose by 10 per cent, so that the industrial-research ratio actually declined by some 6 per cent. While this situation has improved somewhat since 1961, primarily as a result of various forms of government assistance, it will be apparent that we still have a great deal of ground to catch up.

Comparing Canada's performance with other industrial nations, we find that our 1961 national research ratio of 0.85 per cent GNP is relatively austere compared with 1.7 per cent for Sweden and France, 1.4 per cent for the Netherlands and Switzerland, and 1.3 per cent for West Germany and Japan. At the same time, the corresponding U.S. figure has risen to 2.8 per cent and the U.K. ratio is 2.4 per cent owing in part to their higher defence expenditure. Even if the latter are deducted, the balance of their civil R-and-D effort is in the neighbourhood of 1.5 per cent GNP for both countries.

CANADA'S RESEARCH DEFICIENCY

By any standard, it must be admitted that our R-and-D performance is low, particularly in the industrial sector. Moreover, only two-thirds of the 1961 industrial R-and-D figure cited above (i.e. \$77.5 million) or 0.6 per cent of sales, is directly relevant to secondary manufacturing industry, with which we are concerned here. To give some ideas of the order of magnitude of this deficiency, we may draw a comparison with Japan, which began industrialization at about the same time (i.e. around 1900) and which, like Canada, has relied heavily on imported technology in the past. To match the performance of Japanese industry, which has been expending 1.2 per cent of gross sales on R and D, it would have been necessary for Canadian industry to exceed its 1961 effort by a factor of 2.5 to attain an overall level around \$300 million *per annum* (i.e. an absolute increase of about \$175 million). This in turn, would have raised our national research ratio to a more respectable figure of 1.3 per cent GNP. To match Sweden, we should have to increase our industrial-research ratio by a factor of four, and to keep pace with the U.S.A. would require over six times our 1961 expenditure!

RELIANCE ON FOREIGN TECHNOLOGY

Our shortcoming in industrial R-and-D activity may be a reflection of our dependence upon imported technology owing to the subsidiary character of much of our manufacturing industry. In the past, Canadian industry has benefited enormously from the skills and knowledge which have been acquired from our American and European partners, and we certainly hope that this situation will continue where it is to our mutual advantage. However, it must be appreciated that there are also certain inherent disadvantages in relying too heavily upon imported technology. Any industry which is dependent upon licensed or imitated designs will always lag behind the "state-of-the-art" by at least one generation and is at an obvious disadvantage in the export market, quite apart from the problem of competing directly with the

licenser. Nor is it clear that the needs of our domestic market are always best served by this practice, at least to the extent that the Canadian environment differs from other countries. Finally, perhaps the most unfortunate consequence of all is the lack of opportunity afforded to our best graduates in science and engineering to practice their skills in Canada and thus contribute to the progress of their native land.

Hence, while our institutional research in government establishments and universities has shown a steady growth and its level now appears reasonably comparable with other countries, the conclusion seems inescapable that a serious deficiency exists in the scale of effort exerted by Canadian industry toward the application of new scientific advances. This constitutes the "development gap" referred to by Mr. J.R. Johnson in his paper presented at the opening session of this conference... Thus, we are failing to exploit in industry the output of our research laboratories, or even to keep abreast of current advances in the "state-of-the-art".

GOVERNMENT ASSISTANCE FOR INDUSTRIAL RESEARCH

In order to sustain a rising standard of living and provide employment for a growing population, it is my conviction that we must expand the industrial sector of our economy. To do so will require not only a substantial increase in capital investment (preferably from Canadian sources) but also a radical upgrading of the inherent technological capability of Canadian industry; for the achievement of technical superiority in our manufactured products seems the best way to ensure competitiveness and to develop new markets, both at home and abroad. This problem has now been recognized, and the Federal Government has recently introduced a number of specific measures designed to alleviate this critical situation by means of tax incentives or direct financial assistance for industrial research and development in both the civil and defence sectors.

Perhaps the most comprehensive measure in this context is the recent tax-incentive programme whereby firms are permitted to deduct from taxable income 150 per cent of any increase in their R-and-D expenditures (both capital and operating) over the 1961 base year. This programme will remain in force for an initial period of five years, and effectively reduces the net cost of new corporate R-and-D activity to 25 cents on the dollar. Although statistical data are not yet available, preliminary indications are that this scheme induced a 10 per cent rise of industrial R-and-D activity in its first year of operation.

Unfortunately, however, we cannot rely exclusively upon tax incentives to solve our problems because of certain inherent limitations. In the first place, tax remission is not likely to benefit the young or rapidly-expanding firm, which is usually not in a profit-making position. Nor will it appreciably help the small specialty firms (where many of the brightest ideas originate), owing to the relatively large volume of business required to support even a minimal R-and-D effort on any continuing basis. Finally, to achieve progress in the more highly speculative