

tively disproportionate development of scientific research and advanced technology in Canadian industry are many, and cannot be detailed here. They bear a close relationship to the general Canadian industrial climate, including such factors as size of markets, tariffs, transportation costs, subsidiaries of foreign companies, and in particular the absence of extensive government military and space programs. It also must be admitted that in the face of a rapid university expansion in the recent past, industrial laboratories have not competed successfully for their share of top scientific and engineering talent. It is sometimes claimed that to-day's graduate is too strongly academically oriented and not interested in industrial research, and those that are, frequently look to industries in the United States in the belief that industrial research opportunities are lacking in Canada. Some of these difficulties could be overcome by a greater strengthening of the ties between Canadian industry and the engineering schools.

Our competitive position in world markets and our industrial and economic expansion in Canada will depend to an increasing degree on advanced technology. Presently, there exists a number of programs, including those of the National Research Council and the Department of Industry, which are intended to promote and assist industrial research and development. The results from these programs have been encouraging, but they are as yet modest programs and fall far short of what is needed. Some well planned and integrated programs are necessary to generate the momentum needed in this area.

While we have had a continuing shortage of highly trained research manpower in the past, according to the most recent study now being completed by the Council, this picture is likely to change rapidly because of the expansion of our universities and particularly university graduate training in recent years.

Chart I displays the number of new Ph. D. graduates in science and engineering in each year during the period from 1959 to 1968 and projected to 1973. In this study, Ph. D. graduates were used since there is a correlation between research activity and manpower trained to this level. In round figures the annual output of new Ph. D.'s has increased from over 200 in 1959 to a projection of

around 2,000 per year in 1973. (These figures do not include Ph. D.'s in the Medical Sciences). The annual number of new employment positions has increased from somewhat over 400 to nearly 1,000 and is not expected to increase greatly beyond this figure. While these projections are subject to limitations and uncertainties, it does appear that we will no longer be faced with an overall deficit in scientific manpower.

The second feature displayed by Chart I is the distribution by sector, of the new employment positions. The rapid rise in Ph. D. employment over the last 10 years is directly related to the rapid university expansion and the universities themselves have been taking up most of the new graduates. In the future, while the rate of university expansion is expected to be more modest, the universities are likely to continue to employ the largest number of new graduates, with government employing slightly increasing numbers, and there does not appear to be an increasing demand likely to be forthcoming from the industrial sector, under present conditions. This general picture, however, must be strongly qualified. The figures represent an average over all disciplines and there is considerable variation among different disciplines. In many disciplines shortages may be expected to extend well into the seventies. The requirement for new employment positions is basically a projection of existing activities and programs and involves the assumption that no major new government-sponsored programs will be launched during the next few years. With the greater availability of scientists and engineers at the Ph. D. level, it is very likely that in future an increasing number will be absorbed by technical schools, community colleges and other post-secondary institutions. Account must also be taken of the fact that the projected number of graduates include a considerable number of foreign students and the number likely to return to their country of origin is unknown.

Chart II illustrates the distribution among the three sectors of Ph. D. scientists and engineers in another form. The total average number of Ph. D.'s employed in all sectors was 4,300 for the period 1959-63 and is projected to rise to 11,500 in 1973.

Senator MacKenzie: Mr. Chairman, may I ask one question. Does that include all the Ph.D.'s or only those in science?