

pollution, corrosion prevention, and water treatment. Other studies contributory and supplementary to the main branches of work are carried on in the fields of physics, biology, petrology, statistics and mathematics. Operations research studies are used in determining optimum policies and procedures in vehicle replacement, inventory control, reserve transformer capacity, economic power dispatch of hydro-thermal systems, and time-series forecasting of power demands and lake levels.

Subsection 3.—University Research

For many years research in the universities was directed toward obtaining knowledge for its own sake and was considered pure research. Later it was recognized that the conclusions of such research provided the basic information for applied science and before long the universities, because of their unique position in having trained specialists and equipment, were involved in both basic and applied research. During World War II they were encouraged to undertake emergency and other contractual research and since then the trend toward broadening the field of research, increasing the capacity of universities to educate advanced students, and procuring large-scale costly equipment has shown rapid advance. This has created new problems but has provided even greater opportunities for undertaking sizable projects which could not have been attempted otherwise, and has thereby tended to knit the university into the very warp of industry.

Research conducted in the universities falls into three broad categories: projects undertaken by the student under the guidance of a professor or committee to meet requirements for an advanced degree; research undertaken by the professor, which may be of a more or less continuous nature; and larger research projects undertaken co-operatively on a faculty or inter-faculty basis in university laboratories or in such specialized institutions connected with the university as medical research laboratories, institutes of microbiology and hygiene, science service laboratories and faculties of agriculture.

At the turn of the century only two universities in Canada were offering graduate work (Toronto and McGill) and few students proceeded to advanced studies. Growth was slow and uneven until after the Second World War, but then accelerated sharply. By 1960 there were 14 schools of graduate studies and at least ten other universities, some rather large, carrying on graduate work in one or more fields. Most of the graduate schools register several hundred students and the rate of increase in enrolment in these schools in recent years has been greater than that at the undergraduate level.

Not only is there a continuing increase in the number of graduate students and staff members engaged in research at universities, but both the scope and magnitude of current projects are vastly different from those undertaken during the early years of the century. At that time many of the experiments could be carried out with equipment such as glass tubing and dry cell batteries but now universities require for some of their research projects equipment costing hundreds or thousands of dollars, such as electron microscopes, mass spectrometers, cyclotrons, cobalt bombs, and electronic computers. The total range of individual or group projects is encyclopaedic. A few of the exciting new developments include: high altitude research (one project involves the projection of test materials and instrumentation 600,000 feet into space), an intensive study of ocean depths, further investigation into the cause and cure of cancer, and the unfolding of Canada's past through historical and archaeological research.

This increasing volume and cost of research places a heavy strain on the universities. The amount and kinds of research are limited by the availability of trained research specialists, the difficulty of providing adequate space and equipment, and the problem of securing necessary financial backing. Just under 15 p.c. of the total income of universities is spent on research, and the dollar value of research undertakings has increased from \$5,000,000 in 1952-53 to \$14,000,000 in 1959-60.