

ships and marine air-cushion vehicles and a large project is under way relating to navigational improvements of the St. Lawrence River in summer and winter.

Air transportation activities relate to the development and certification of new engines. In particular, research and novel investigations have been concentrated on engines appropriate to VTOL (vertical take-off and landing) aircraft.

Recent work in the manufacturing field is concerned with the application of two-phase heat transfer pipes to the maintenance of permafrost in areas of arctic construction, and with the de-icing of navigational buoys in waters off the Canadian east coast. Another project is the use of high-pressure water jets for cutting various kinds of materials.

Newsletters publicizing manufacturing processes not yet in general use in Canada are being widely distributed and have given rise to a most enthusiastic response through Canadian industry. Examples of the new technologies include the generation by grinding of precision case-hardened gear teeth, the generation of complicated shapes in a variety of materials by electrochemical machining, and the application of numerical control for much greater productivity of machine tools on single articles or small lots. In a number of instances, these technologies have proved of valuable consequence to Canadian industry.

In addition to the calibration of instruments, lubricating oils, fuels and various apparatus for Canadian industry, the various laboratories of the Division have been involved in the certification of the airworthiness of helicopters and various gas turbine engines in conditions of snow and sleet.

Because of the expense involved in the construction of prototype machinery and in arranging complicated experiments even with conventional machinery, the application of computers to the simulation of projected machinery performance has become very important. Typical examples of Division work pertain to the investigation of the parallel operation of compressors on gas pipelines; the transients resulting from changes in operation and the corresponding controls; systems analysis of certain control components and the general control features of a new nuclear power station, and of a hydro-electric power station (in collaboration with the University of the West Indies); dynamics of high-speed railway container cars; and new designs of reciprocating engines.

Work in progress in the development of new instrumentation for medical and surgical purposes ranges from the design of prototype instruments for extremely difficult operations on the spinal cord to final arrangements for production and marketing of a suturing instrument for blood vessels; the first activity is a collaborative one with the Montreal Neurological Institute and Queen's University, and the second is related to the licensing of a Montreal manufacturing firm.

Work continues on the industrial application of control theory — mechanical, electronic and fluidic, and the application of control system technique to animate beings. In particular, a considerable body of work has been accomplished in relation to the effects of microwaves on birds, and work relating to the possible supply of electrical control impulses to the muscular system of paralyzed people has begun. Conversely, progressively more detailed investigations are being made of biological control systems as possible models for better and more reliable engineering systems.

In order to establish an even closer liaison with Canadian firms and other organizations, the Division of Mechanical Engineering began in 1971 to set up some laboratories in Vancouver for this purpose.

The National Aeronautical Establishment conducts aeronautical research to meet the needs of military and civil aviation, working in co-operation with the Canadian aircraft industry. It studies problems of aerodynamics, aircraft structures and materials, and flight mechanics. It has the only development wind tunnel facilities in Canada and is equipped to handle most of the industrial or military aircraft developments of the foreseeable future. Aerodynamics research from low speeds up to about 17 times the speed of sound is carried out in the wind tunnels; considerable attention is being given at present to low-speed problems of vertical and short take-off aircraft. Other studies include work on the aerodynamic characteristics of high-thrust propellers, on wings with submerged fans and on wings immersed in powerful slip-streams. The research on structures and materials involves investigation of aircraft accidents, the theory of structures, fatigue and fracture, flight load statistics and aircraft hydraulics. The flight mechanics program covers research on flight safety and flying stability