Electronuclear breeding of fissile material, plutonium from U^{238} or U^{233} from thorium, would make CANDU reactors virtually immune to uranium resource depletion. A system comprising a fusion reactor surrounded by a blanket of fertile uranium or thorium is one possibility, but no development is planned until feasibility of the fusion process has been demonstrated elsewhere.

The spallation process for neutron production is the long-term basis of our current laboratory work. It depends on a highly efficient accelerator to direct a beam of protons onto a heavy element target. Accelerator research and development for this purpose is a major activity and progress is exploited in medical therapy, industrial irradiation and research applications.

Heavy water processes. A high level of development is necessary to back up the rapidly growing heavy water production industry and to achieve cost reductions. AECL is directly responsible for the heavy water plants at Glace Bay, NS and LaPrade, Que.; plans to transfer the Port Hawkesbury, NS plant to AECL were announced in 1974. R&D activities relating to heavy water plants are analogous to power system activities and draw on many of the same disciplines.

Underlying research. Fundamental research has always been, and must remain, the basis of AECL's development, and the major special tools for this research are the three high-power experimental reactors WR-1, NRU and NRX. Not only do these reactors have provision in their cores for the irradiation of materials over extended periods of time, but special isolated fuel channels, or loops, are provided for the in-reactor testing of different fuels and coolants — such testing being fundamental to the Canadian power reactor program. Horizontal holes through the reactor shielding allow intense neutron beams to be directed to various experimental research facilities.

The NRU reactor with its increased neutron flux and improved experimental facilities resumed operation in 1974. Programs in solid state and nuclear physics, as well as a host of related research fields are greatly enhanced by the upgraded facility.

A further major research tool at CRNL is the "MP" tandem Van de Graaff accelerator. Among its many uses are precise studies of the structure and excited states of heavy atomic nuclei. Data acquisition and analysis equipment associated with the accelerator is on-line to powerful data processing systems. Successive improvements have greatly increased the usefulness of the tandem. It has recently been fitted with a Pelletron charging system. The planned addition of a superconducting cyclotron post-accelerator will open an enormous research field in the interaction of heavy particles.

Photonuclear physics, using beams of gamma-rays and electrons to produce photo-neutrons and photofission promises high yields of new information.

Research in Chemistry and Materials Science is concerned with isotope exchange chemistry, analytical sciences, chemical and physical effects of radiations, properties of surfaces and the relationship between the microscopic structure of solids and their physical and chemical properties.

Research with the new High Voltage Mass Separator is increasing emphasis on programs of radiation damage, atomic collision and ion penetration in solids. Studies of the chemical effects of radiations relate to reactor systems and to biological processes.

Surface chemistry and physics are of growing importance in solving corrosion, wear and mass transport problems. Advanced electron microscope techniques and other materials research methods yield information leading to improved materials for reactor systems.

Environmental research covers a wide spectrum of activities within AECL and at several Canadian universities under research contracts. At WNRE a Field Irradiation Gamma (FIG) Project is under way to determine the ecological changes resulting from an increase in background gamma radiation levels. At CRNL an entire lake is used as a real life laboratory to study the effects of trace amounts of radiation on the food chain and ground water systems. Further work is in progress to examine the impact of thermal enrichment upon the ecosystem. Evidence is mounting that some degree of thermal enrichment in cold environments is beneficial to the production of aquatic food supplies. This exciting new field (Aquaculture) will become the subject of more intense studies in the future on both national and international levels.