a variety of control methods including bacteria, viruses, predators, sex attractants and growth-regulating hormones.

The most effective agent found so far is *Bacillus thuringienis* (usually called Bt), which has a protein that is toxic to a broad range of insect larvae. It has been used successfully to protect cabbages from pests for twenty years. One advantage is that it affects only a few species, particularly the spruce budworm, the hemlock looper and the tussock moth, all destructive insects, and leaves other, harmless species unharmed.

Biological controls have on occasion proved dramatically successful. A $300,000 pilot program in 1940 stopped the infestations of the European spruce sawfly in the Gaspé peninsula of Quebec after it had destroyed half of the spruce there. In 1970 a winter moth control program costing $500,000 saved an estimated $45 million worth of red oak.

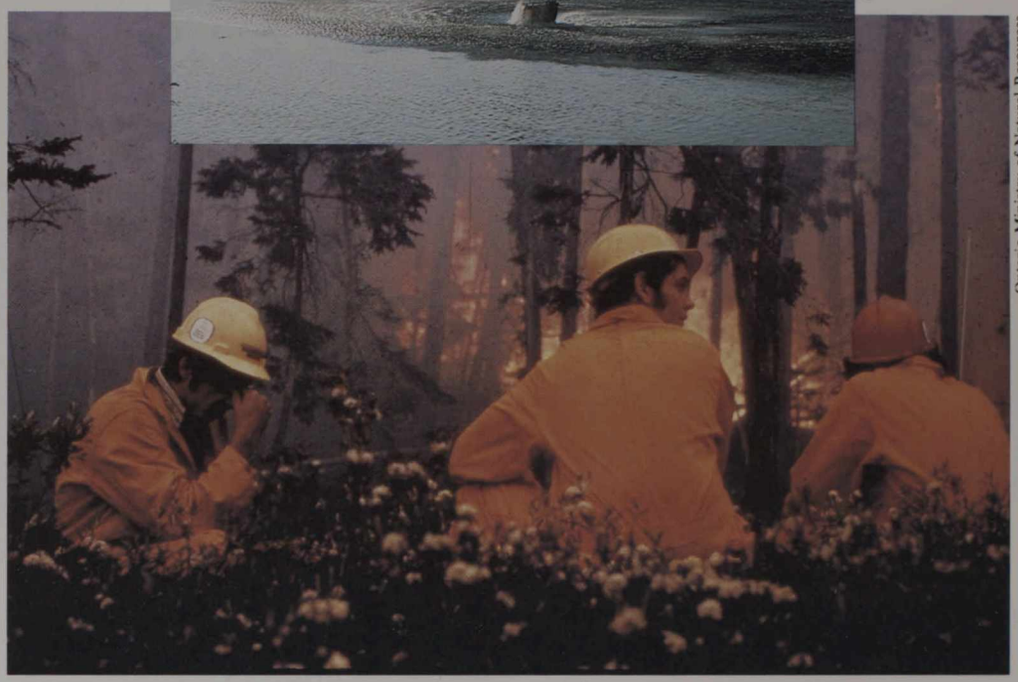
Other non-biological control programs are still in experimental stages but some are promising.

Sexual attractants duplicate the natural smell of female insects. They are sprayed over forests, confusing the males who, after many false alarms, grow indifferent to the real thing.

Autocidal controls involve the introduction of sterile or genetically different pests which attract males but produce no offspring.

The progress in both sexual attractant and autocidal controls has been slow but advances in genetic engineering promise to speed things up. Present prospects are that such controls may prove practical for use in high-value stands of trees in seed orchards.

Canadian Forestry Service



Ontario Ministry of Natural Resources

Fighting Forest Fires

Forest fires destroy 5 million acres of Canadian forests in an average year.

The Canadian and United States forest services fight fires together, exchanging intelligence, equipment and personnel, regularly and routinely as needed.

The fire losses—which average $101 million a year in Canada—would be much higher if it were not for cooperation with the U.S. and the use by both services of highly sophisticated techniques, including satellites, computers, helicopters, sensors and water bombers as well as water, dirt and shovels.

The first line of fire defence is weather reporting. The Canadian Forest Fire Weather Index predicts fire based on temperature, relative humidity, windspeed and rainfall. A computerized information bank adds data on thunderstorm paths and historical patterns.

The second line is sensors in the forest which detect lightning as it hits the ground. Ten seconds after it strikes in a northern Ontario forest a blip appears on a computer screen 740 miles away. Helicopters and planes take off, some with parachutists.

After locating a new fire a crew lands by helicopter, lays out hose and pumps water from the nearest lake. (In northern Ontario a lake is always handy.)

The pilot radios for water bombers and they arrive in minutes. Each one carries six tons of water. They dump it all at once, with enough force to knock down trees, then fly low over the lake, scooping up another 1,430 gallons, and return to the fire within five minutes. A bomber can make twenty drops an hour. In areas where no lakes are nearby the bomber carries 3,000 gallons of chemical retardant.

Meanwhile a helicopter crew member is cutting down burning trees with a chain saw. In most cases the flames are out in an hour but the crew continues to drench the embers for six more hours.

Three per cent of the fires cause 95 per cent of the damage. If a fire gets out of hand it creates its own weather and becomes virtually unstoppable until it burns itself out.