Capsules

Confusing Cupid

Along the South Saskatchewan River, near Saskatoon, is a 10-km stretch of woodland that causes misery in the amorous endeavours of the Forest Tent Caterpillar moth. Somehow, the males just never seem to be able to find their prospective mates. Their quest for conjugal happiness is being deliberately thwarted by scientists from NRC's Prairie Regional Laboratory.

Forest tent caterpillars are incredibly destructive of hardwood trees in North America. In urban and recreational areas, caterpillar infestations have been traditionally controlled by insecticide spraying, a controversial technique that causes damage to far more than just tent caterpillars. To get around this, the scientists from Saskatoon are using the natural mating behaviours of the adult moths to decrease the population of caterpillars.

In the mid-summer breeding season, female moths sit in one place and release a mixture of chemicals, called a sex pheromone, that the male moths use to track in on. As the concentration of the pheromone in the air increases, the flying male moth senses that he is getting closer to the female. The pheromone secreted by a given species attracts only the males of that species, making it a highly selective attractant indeed. It is this particular pheromone that Mel Chisholm, Pachagounder Palaniswamy, and Ted Underhill are using to confuse the male moths. In the laboratory, they isolated and analysed the pheromone, and then synthesized it. They have since found, through field tests, that releasing small amounts of the chemicals into the air totally confuses the male moths. With no odour gradient, only a permeated atmosphere, the males are hopelessly disoriented, and locate females only by chance, if at all.

This pheromone is only one of many that have been successfully isolated, analysed, and synthesized in the Saskatoon laboratory.

Subatomic "weakling"

The recent discovery of the long-elusive subatomic "W" particle may provide a key to physicists' understanding of the basic forces that govern the universe.

The W particle has been sought for almost half a century because it has been assumed to carry one of nature's four basic forces, the "weak" force, which is believed to control radioactive decay. The detection of the W particle, by a team of European and American scientists working at the European Centre for Nuclear Research (CERN), provides the strongest support yet for theories that two of the forces, the electromagnetic and the weak, are part of the same phenomenon.

The universe, according to physicists, is held together by four basic forces: the electromagnetic force which binds atoms and molecules, the "strong" force which holds the atomic nucleus together, the force of gravity, and the weak force. Ever since physicist Hideki Yukawa published an historic paper in 1935, scientists have believed that each force is exerted by the transfer of some sort of particle. Yukawa successfully predicted the existence of particles, later called mesons, which carry the strong force. He also assumed the weak force was carried by its own subatomic particle, later dubbed the W particle.

During the five decades since then, physicists have sought to learn more about the W particle and have tried to confirm unification theories that say the electromagnetic and weak forces are actually part of the same force, carried by different intermediary particles. According to these theories, the electromagnetic force is strong because it is carried by photons, long-lasting subatomic particles with no mass. The weak force, on the other hand, is weak because it is carried by W particles, which are massive and short-lived.

The detection of the W particle not only helps to confirm these theories but could be a crucial step toward validating the so-called grand unification theories, which claim that all of nature's basic forces are simply different aspects of a single force.

The W particle was identified in experiments at CERN's giant particle accelerator, a 6.4 km circular tunnel, located north of Geneva, which is used to accelerate billions of protons (which with neutrons make up the nuclei of atoms) against a beam of antiprotons, their antimatter twins. When the protons and antiprotons collide, they are transformed into a great flash of energy, spraying a shower of subatomic particles.

These particles are too minute and short-lived to be seen under any microscope, but they leave trails that can be seen as they pass through a sophisticated detector array. The energy, mass, and other characteristics of each particle can be calculated from the curvature of its track in a magnetic field as well as its behaviour in other parts of the detector. After examining tracks from about one million collisions, the CERN team was able to identify six collisions that showed evidence of a particle that fits the theoretical description of the W particle.

In the next four months, CERN researchers will continue the experiments in the hope of confirming these initial discoveries. They also expect to find evidence of the Z particle, a slightly heavier counterpart of the W particle that has no charge.

Physicists are also eagerly awaiting construction of a mammoth new particle accelerator to be built beside the CERN accelerator and completed in five years. Because of this accelerator's immense size (27 km in cir-