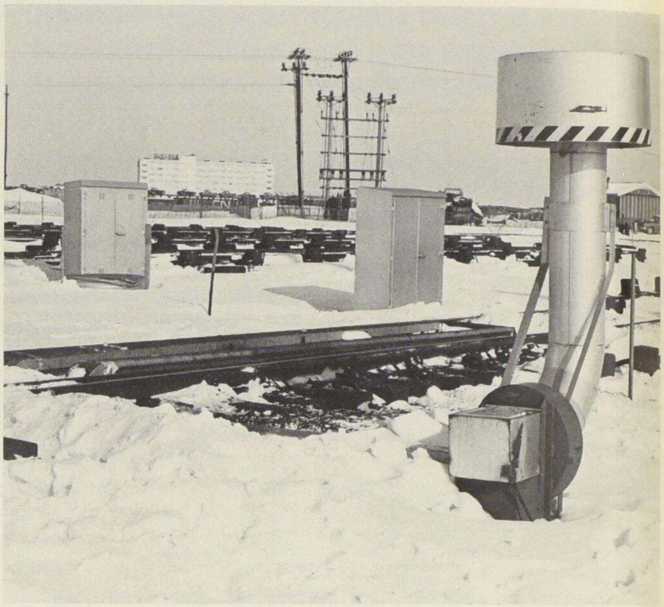
track section, used in France and Germany for both air cushion and magnetic levitation vehicles, proved to be totally unsatisfactory for Canadian use, and the channel section, widely used for experimental vehicles in the United States, was little better. "The most satisfactory design proved to be a simple rectangular box beam section," Mr. Ringer points out, "this design accumulating the least amount of snow."

While the rectangular track section does not accumulate as much snow as the other designs, it does collect some, and snow removal from such tracks is another aspect of the Low Temperature Laboratory program of snow investigation. Conventional snow removal equipment, such as ploughs or snow throwers, appear to be limited to speeds of about 60 mph (100 kph). "Now, obviously, you can't mix 60 mph snow-clearing vehicles with 150-250 mph (240-400 kph) traffic (the sort of speed range we're talking about for air cushion vehicles or maglev systems)," explains Mr. Ringer. "If you have a high-speed track system, you must be able to clear it at high speed."

The Laboratory's attention then, is being directed to non-contact methods of snow removal which might be suitable for high-speed use, one of the main lines of investigation being the use of air jets. It has been found that for most snow conditions, even quite low velocity air jets are capable of removing snow from a surface with a high degree of efficiency. However, problems have been experienced when dealing with "fully sintered" snow with high cohesion and adhesion strength and much development will be required in order to produce a viable high-speed snow removal system.

Interestingly enough, it was the work on air jet methods of snow removal which led the researchers of the Low Temperature Laboratory to a development which promises to be of considerable significance to Canada's railways. If rail track switches are not kept clear of snow they become inoperative — even quite small amounts of snow are sufficient to prevent complete closure of the switch. For the Canadian railway network, with its large proportion of single-track line (necessitating the use of sidings), the failure of even one switch can cause significant dislocation. Conventionally, switches have been protected thermally, using flame impingement heaters or forced convection heaters. Some years ago, the Low Temperature Laboratory devised a switch heater based on the pulse jet principle. Thermal heaters function adequately under ideal conditions, but if conditions are slightly less-than-ideal, then several drawbacks to their use become apparent. Firstly, heaters can set fire to the ties, "burning out" the switch; secondly, having melted the snow, they then shut off and if the melted water cannot drain away it will re-freeze, jamming the switch even more solidly than the snow; finally, all thermal devices tend to warm up the frozen ballast, which then becomes "soft" and will settle an inch or so after the passage of trains, requiring subsequent shimming to bring it back into line with the rest of the track.

"The ultimate answer to this problem," says Mr. Ringer, "is to design a type of switch that will not be vulnerable to snow or ice jamming. In this Division, we're working on two designs and have reached the prototype stage with both, but these are long-term answers. An immediate solution to the problem of conventional switch protection was required." During the work on air jet methods of snow clearance, it had been noted that once snow was lifted by the air jet it could travel for appreciable distances. Might it not be possible, the researchers at the Low Temperature Laboratory reasoned, to use an air jet to deflect falling snow from track switches? With this in mind, a system was devised that would maintain a horizontal sheet of moving air across the switch rails. Snow would fall to this moving airstream and be swept aside, well clear of the switch.



The air curtain switch protection system installed in the Montreal marshalling yard. At right (foreground) can be seen the air intake and blower, the intake being hooded to prevent snow ingestion.The horizontal air curtain's effective protection of a railway switch is clearly shown, the immediate area around the switch being almost completely clear of snow.

Le système de protection des aiguillages à l'aide d'une lame d'air soufflée dans la gare de triage de Montréal. A droite (au premier plan) on voit l'entrée d'air (couverte pour empêcher la neige d'y entrer) et la soufflante. La protection efficace d'un aiguillage par la lame d'air soufflée est ici mise en évidence puisque la région autour de l'aiguillage est presque entièrement déneigée.

The system developed was a relatively simple one, comprising an air inlet, a fan and two ducts located between the switch rails and parallel to them. A carefully-designed slit running the length of each duct guides a high-speed (about 150 mph or 240 kph) sheet of air across each rail. This system, in prototype form, has been tested through three winters with a cumulative snowfall of 267 in (6.8 m) without failure. Two prototype versions of the system were installed on operating switches in Montreal's main marshalling yard and performed successfully throughout last winter. "You may recall," says Mr. Ringer, "that we had a rather nasty storm during the first week of April this year. Well, that storm was worse in Montreal than we experienced in Ottawa, with higher windspeeds — in the 40-60 mph (65-100 kph) region— combined with a 12-inch (30 cm) snowfall. The marshalling yard was so badly affected that it had to be shut down. At the end of the storm, the only functioning installations in the yard were the two switches protected by the air curtain system. All the other switches — about one hundred of them — were unserviceable."

Another strong factor in favor of the air curtain switch protection system lies in the energy conservation field. Conventional thermal switch heaters can consume up to 250 000 BTU/hour whereas the air curtain system, using only a 5 kW electric motor, has an equivalent energy "cost" of approximately 65 000 BTU/hour (assuming a fossil fueled electrical generating plant).

The development of this system by the National Research Council's Low Temperature Laboratory is one example of how applied aspects of a long-term research program can be put to the solution of a present-day problem. □

David Mosey