Last February in Nova Scotia there was a "wheel turning" ceremony to mark the start-up of the Lovat Tunneller, a new means of mining Maritime coal. Science Dimension*'s Bill Atkinson was there.*

Donkin, Cape Breton Island: Two immense concrete gates, or portals, mark the opening to the mineshafts at the Donkin-Morien test site. Today, many modern mines begin like this — a ramplike tunnel sloping into the earth rather than a vertical hole with branching galleries. This permits material to be brought out continuously by conveyors and reversing trucks. Here, within the portals are the sites of this morning's demonstration. Inside the first, our party sees the results of traditional drill-and-blast mining: jagged scars and gaping cracks oozing water. That would be disconcerting if this tunnel were a thousand metres longer and deep beneath the sea. The light and winter air back at the portal top are welcome.

Through the other portal snake black rubber cables supplying power to the Lovat tunnelling machine below. In the last week, this great mechanical worm has burrowed nearly five times its length into the Cape Breton bedrock.

Since similar electric-powered machines will soon be mining coal to be burned in power plants, they will really be digging for their own food. This borer has not yet been turned on today, but along the tunnel we see signs of its passage. The walls about us are as smooth as if they have been plastered. An engineer informs us that the Lovat tunneller leaves walls like this, which are then hand-fitted with steel or concrete liner panels.

In groups of five, we enter the tunneller itself, a reinforced cylinder 4 m in diameter. The machine moves ahead by pressing against the liner panels behind it. The six hydraulic pistons that control the process can be operated individually to swivel the borer's head, letting it attack the rock at an angle. The Lovat tunneller can actually steer its way through solid rock.

Dr. Larkin Kerwin, President of NRC, activates the controls. A series of *whooshes* rising in tone signal the startup of the tunneller's 300-HP (224-kW) electric motors, which in turn drive hydraulic pumps. Before us, the inside surface of the new cutting head starts to revolve. Heavy slabs of stone and clay fall on the central conveyor and are pulled back toward the surface. The noise is tolerable; there is no need to shout. Spotlights send narrowing shadows through the dust. In routine operation, Lovat tunnellers use a water spray to lubricate the head and clear the air; operators — one almost hesitates to call them "miners" any more — will not even need to breathe through masks.

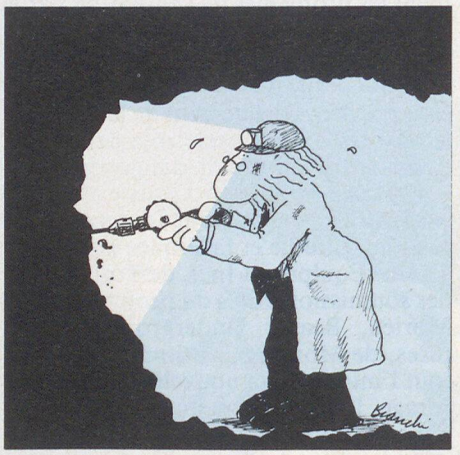
The test is over. Controls are adjusted; solenoids snap. The machine has already done in minutes what it would have taken a team of men with drills and explosives an hour to do. We turn and troop back to the surface, which seems strangely less sweet than it had after Portal One. Why is that? Is this mine now so much less threatening?

400 m of solid rock and an ocean overhead. Here, too, technology offered a solution — in the form of huge machines for boring tunnels through rock. Tunnelling *is* gentle: a borer leaves behind a smooth wall which distributes stresses better, lessening the chance of cave-in; that makes it much easier to provide essential ventilation, since the smooth tunnel provides less resistance for the fans that move air around. For much the same reason that a drill will not split a plank where a nail would, a tunnel creates a safer working environment.

Beaver Underground Structures of Montreal, bidding on the Donkin-Morien project, saw the logic of the new approach to mining; it had been convinced by using a Canadian soft-ground tunneller produced by Lovat Tunnel Equipment Inc. of Toronto. Lovat tunnellers had already proven themselves among the best of their kind in the world. They are rugged, sophisticated, and dependable. In one Beaver contract for boring sewer lines in Kansas City, a Lovat machine had outdistanced its nearest competitor by 50 per cent over two years.

Beaver wanted to involve Lovat technology in mining Cape Breton coal, but existing Lovat machines were designed for working in earth, not rock. Could the National Research Council help this Canadian consortium bid on the Donkin-Morien project with a more advanced technology?

Indeed NRC could. Within five weeks, a contract was in place with



Richard Lovat, underwritten by NRC and the Department of Supply and Services, and totalling just under a million dollars. Under the terms of the contract, Lovat would modify the machine that had performed so well in Kansas City by developing a new cutter head capable of boring through rock of up to 15 000 psi (104 000 kPa) compressive yield strength — the typical strata surrounding Nova Scotia coal. Rushed to completion in nine months, the modified tunnelling machine was demonstrated to reporters and Government officials at the Donkin-Morien site on 16 February 1982. The test was a complete success (see box).

What's in this for Canada? Before approving the Lovat contract, NRC's Program for Industry/Laboratory Projects identified large domestic and offshore markets for hard- and soft-rock tunnelling machines of Canadian origin. Materials such as potash could also be mined more safely with soft-rock capability; and there is the very attractive possibility that Western tar sands could be exploited without the ecological disruption of current open-pit methods. If machines of up to 7 or 8 m diameter could be developed to bore through the tough granite of the Canadian Shield, then metals such as gold, copper, and silver could also be mined, faster and more safely than ever before. Finally, there is the positive feature of having a Canadian industrial base for producing this equipment. We would not be put in the position of making money on minerals only to spend it again on mining machinery; and our construction companies could develop tunnelling know-how close to central service help and parts supply. NRC acknowledged this when it agreed to participate in a multi-departmental contract with DSS and Lovat in April 1982 for development of a completely new 7.5-m tunneller to be ready in April 1983. □

Bill Atkinson