BACK BOX

What whips up a tornado's whirl

'It came with a roar like an express train.' Thus people commonly describe the sound of approaching tornadoes. The roar, of course, comes from their winds, which may reach 350 km per hour.

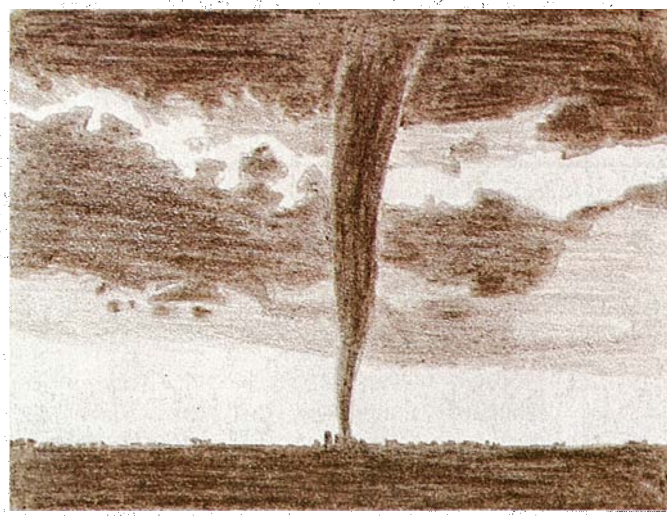
Tornadoes, Nature's most violent storms, strike most often and at their most furious in the United States.

We have them here too, and they're not as uncommon as people may think. Although not as powerful as the strongest of their American counterparts, some 15 strike New South Wales each year, and an average of five are reported in Victoria. Melbourne suffered from 11 between 1947 and 1958—an average of one a year. No State escapes them completely.

Scientists have very little information about tornadoes—they are such ephemeral and localized events. They rarely last for more than half an hour—most only for a few minutes. And their funnels only have a width of between 100 and 1000 metres at ground level.

So it has been very hard for anybody to explain satisfactorily why these whirlwinds start, why they form only in storm clouds and never in still air, or why few of the storm clouds that should spawn them actually do. Then there are other puzzling features to explain—like why the majority of tornado funnels fail to reach the ground.

In the absence of hard facts, about the only way that scientists can try to understand



A 'twister'—Nature's most violent storm.

these storms is to create models that behave similarly. So far, neither making physical models in water baths nor creating mathematical ones in computers has given entirely satisfactory results.

But Dr Roger Smith, at Monash University, and Dr Lance Leslie, at the Australian Numerical Meteorology Research Centre in Melbourne, have now come up with a mathematical model of tornadoes that, they believe, comes the closest yet to the real thing.

For example, they can correctly simulate these storms' core sizes, the strengths of their vortices, the reduction in pressure across their vortices, and how rapidly each storm grows.

The two mathematicians believe that tornadoes begin as strong updraughts in thunder clouds. These updraughts draw in air towards themselves from further out in the cloud. This incoming air spirals around the updraught, rotating faster and faster as the turning circle becomes smaller.

As the air spins faster, so the outward-thrusting forces caused by its rapid spin increase. In time these outward-thrusting forces come to balance the opposite ones, causing the vortex to become smaller.

The embryo tornado is now like a tube spinning vertically around the updraught in the middle of the storm cloud.

At its lower end the tube sucks in air from lower down in the cloud. This additional air also rotates with increasing rapidity until the forces on it too come into balance. Thus the tube extends earthwards, the 'tail' elongating until it reaches the ground.

Once the vortex has touched the ground, the funnel-like tornado may be expected to peter out, since no more air can be sucked in at the base to feed the updraught. But friction at ground level slows down the tail's speed of spin, with the result that air from a thin layer near the ground can still be drawn in. The updraught thus continues, and the tube of air goes on whirling around it.

So the tornado moves across the landscape—its updraught, and hence its stability, being continuously maintained.

Dr Smith and Dr Leslie believe that the initial updraught and rotation strengths must fall within narrow limits. Otherwise no vortex will form in the cloud. Furthermore, there must already be some rotation in the air below the vortex, or else it will die out. This explains why so few thunderstorms give off whirling funnels, and why even when they do very few actually reach the ground and become tornadoes.

New radar techniques developed in America have enabled scientists there to identify tornado 'signatures' in thunder clouds. Observations using these new techniques have indicated that the vortex really does begin to form in the mid levels of the cloud at 4–5 km altitude. The tail descends to the ground about half an hour later. The model of Dr Smith and Dr Leslie explains how.

The effect of vertical stability on tornado-genesis. L. M. Leslie and R. K. Smith. *Journal of Atmospheric Science*, 1978, **35**(in press).