Spectrum

Why do cyclones start?

How cyclones start has always puzzled atmospheric physicists. They know the conditions needed—areas of high humidity with some rotation must be located over a warm sea, which must have a surface temperature of more than 25·5°C. But under these circumstances a cyclone may or may not develop. And having this information doesn't explain why that's so.

Using mathematical models, scientists can now explain how warm, moist, tropical air sucked in at the cyclone's base fuels its spiral motion (see *Ecos* 5). But to date all their calculations have had to assume that this circulation in the storm has already started.

Dr Angus McEwan of the Division of Atmospheric Physics at Aspendale, near Melbourne, has come up with a possible answer to how the motion starts.

He carried out a laboratory experiment to find out what happens when a revolving fluid is stirred.

Our atmosphere behaves as a fluid and, in the early stages of cyclone formation, convection in towering thunderstorms that rise over the warm ocean will vigorously stir it.

Dr McEwan carried out his experiment in a cylinder of water set up on a turntable. In the bottom of the cylinder he had drilled a grid of 199 holes. Through some of these holes he injected water into the cylinder, while through others he simultaneously sucked water out. In this way he imitated the intense stirring of the moist tropical atmosphere that results from the release of radiant heat in the growing towers of cloud.

He could change the stirring patterns in the cylinder by closing off some of the jets and by reversing the flow through some of the holes.

This photograph shows how polystyrene beads moved in eddies that formed in the water bath on the rotating turn-table.

Polystyrene balls added to the water in the cylinder made it possible to follow any movements in the water.

When Dr McEwan turned the system on without rotating the cylinder, the polystyrene balls moved about at random. However, if he slowly rotated the whole system on the turntable many times, the balls began spiralling in eddies that formed in the water.

Once formed, the eddies seemed very stable. Occasionally some merged with others, and then new ones would form to keep the numbers constant. They extended from top to bottom of the cylinder of water and drifted about, apparently uninfluenced by the locations of the water jets at the bottom of the system.

This all sounds simple enough. What it shows is that small-scale stirring motions in a revolving fluid can give rise to much larger rotating eddies. This may well apply not only in the small laboratory experiment but also in the atmosphere —provided conditions of rotation and convection are suitable.

The phenomenon can be represented mathematically. When scaling up his calculations to represent a realistic situation where a cyclone can form, Dr McEwan calculated that some atmospheric disturbances may indeed intensify into rotating depressions within a few days.

Once the depression has intensified it seems that the normal processes that power a cyclone can take over. Adequate energy can come from warm moist air from the sea surface spiralling into the depression's centre and then rising rapidly at the core.

Angular momentum diffusion and the initiation of cyclones. A. D. McEwan. *Nature*, 1976, **260**, 126–8.