Taking on a New Shape

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Rotating Polygons. Credit: Thomas Jansson.

“It is seldom that you see a new stable structure appearing spontaneously in a completely symmetric environment,” explains Tomas Bohr, a physicist at the Technical University of Denmark. “Usually you have to do something to break the symmetry. But we’re not doing anything to break the symmetry. The system does it all by itself.”

The unusual phenomenon in question involves rotating a bottom plate under a liquid in a circular (cylindrical) container. Bohr and his team of students at the Technical University and at the Niels Bohr Institute set up an experiment to find out whether or not such conditions would lead to stable deformations of a water surface into polygon shapes. The findings from their experiment were published May 3rd in *Physical Review Letters*.

Rotating Polygons. Credit: Thomas Jansson.

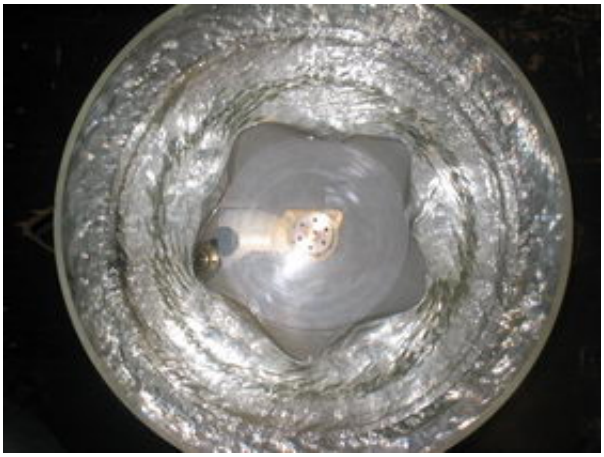
Bohr tells *PhysOrg.com* that a somewhat similar experiment took place eight years ago with a different team (including Clive Ellegaard and others). “We had fluid falling on a plane, like water from a faucet. We found that even if the rim of the plate is completely circular, the fluid surface can be shaped like a polygon.”

While the first polygon experiment Bohr did involved stationary polygons, the most recent effort shows rotating polygons. “Not only are these shapes rotating,” says Bohr, “but they are rotating at a different speed than the plate beneath them.”

“Nobody predicted that it should behave like this,” Bohr continues. “You start with something that is completely circular, basically like a hand without fingers, and, suddenly, out of nowhere, fingers develop. The fluid is pressed against a round wall, at first in a circular shape, but it wants to become something else, to develop a corner.”

Bohr finds the mystery fascinating. The circle shape demonstrates instability, but when it develops into a polygon (and Bohr's team has found that the polygon can have anywhere from two to six sides), it becomes quite stable and can remain the same for hours. In some cases there can also be slow transitions from one polygon to another.

The findings are related to geophysical phenomena around us. Bohr explains that similar forces are at work on our own planet: "We live on a rotating sphere, and fluids abound in the oceans and in the atmosphere," he explains. "Our experiment might help us know the basic instabilities and properties of systems like that."



Rotating Polygons. Credit: Thomas Jansson.

Right now, admits Bohr, there is little known of these rotating polygons beyond the fact that they exist, and that they behave in ways nobody expected. "We think this is a spectacular phenomenon" he says, "but we don't know why it works. Maybe someone will get a bright idea when they read our paper."

Bohr has plans to continuing examining this phenomenon. “We want to build new containers with different sizes, et cetera, and find ways to probe this more accurately, so we can be sure exactly which conditions are necessary to see the polygons.”

You can see pictures of the experiment, and watch a video, by visiting the Technical University of Denmark’s Rotating Polygons site.

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