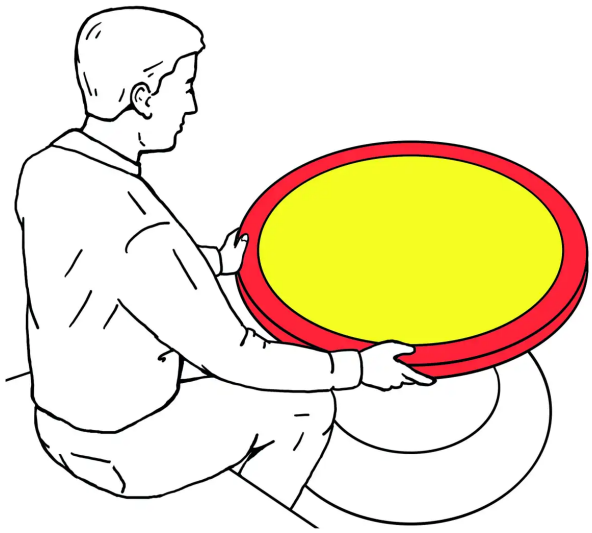
Convection cells

What do cooking and weather have in common?



Look at the structures in the liquid.

Turn the disc carefully.

Stop the disc again.

Watch the liquid.

When the disc is still, regular patterns develop on one side of the disc. These are destroyed when you turn the disc.

There is a heated area under one side of the disc. The fluid above it is warmed, and rises. When it reaches the surface, it cools, and sinks back down, where it is warmed again, and rises again, and so on. The fluid ends up moving in a circle. This circulation causes a regular pattern of "convection cells" to form. The cells are usually hexagons or rolls, but when the heating is too strong, an ever-changing, chaotic,turbulent pattern appears.

This experiment is called the Bénard experiment, after Henri Bénard, who described it in detail in 1900.

Convection patterns like these occur in the Earth's atmosphere (Fig. 1) and in the Sun (Fig. 2). Cloud formation can impressively visualize these convection patterns in the Earth's atmosphere. When cold air flows over a warmer surface, such as cold Arctic air flowing from sea ice over the Atlantic, the air on the ground heats up, rises, and clouds form. Thus, the warm surface of the earth has the same effect on the atmosphere as a warm cooking-pot bottom has on water in a cooking pot that rises when heated in the cooking pot.

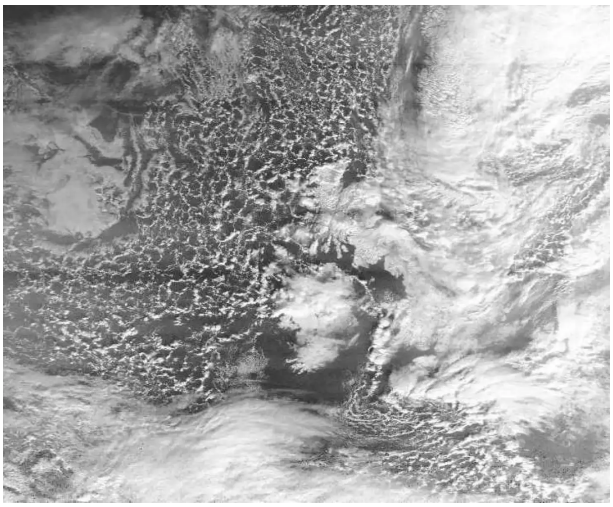


Fig. 1: Convection cells in the Earth's atmosphere over Spitsbergen.

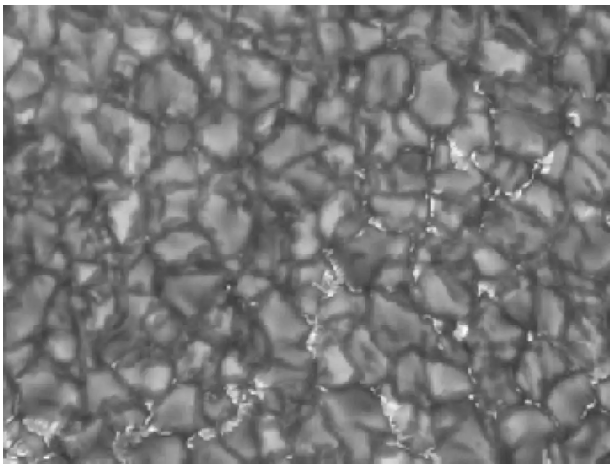


Fig. 2: Convection cells at the Sun's surface. Every cell is almost as large as Germany.