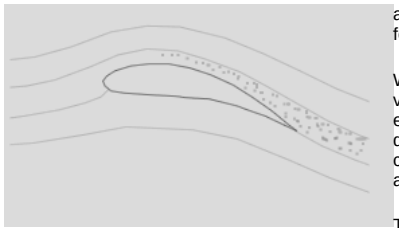
Iridescent aircraft condensation cloud

747 in landing approach to Schwechat Airport, Vienna *imaged by astronomer Franz Kerschbaum (site) in late September 2007.* *Image ©Franz Kerschbaum, shown with permission.*



The iridescence was produced by diffraction of sunlight by millions of water droplets condensed by the airflow over the wings. The droplets had similar life histories and therefore similar sizes, ideal conditions for iridescence. The sun was 30-40° away, indicating that the droplets were small.

Why does condensation occur? Once the pressure of water vapour in the air exceeds the saturation vapour pressure it is no longer stable. Provided there are dust particles present to act as nucle, the excess vapour over the saturation pressure condenses into droplets. Without nuclei, condensation is difficult and instead the air becomes supersaturated. However, when the supersaturation exceeds a certain critical value water does condense out very rapidly as a mist of fine droplets even though nuclei are absent. This is homogeneous nucleation.

The flow over the top of aircraft wings is faster than elsewhere. The fast flowing air is at a lower pressure and expands. In doing so it cools. If the air humidity is high enough and its temperature also fairly high (warm air can hold more water as vapour than cold air) then conditions might be reached for heterogeneous or even homogeneous nucleation followed by rapid droplet growth. In some cases the air might already be supersaturated before the aircraft passes. The result? We see trails of vapour from the wings and other surfaces (note the denser vortices in the Vienna image).

In the above illustartion the droplets evaporated quickly. Sometimes they persist to join the more dense trails formed from the water produced by combustion in the engines.